701/702 Documenting Process Calibrator

Service Manual

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Note

This manual pertains to instruments that do not have CE marked on the bottom case.

701/702

Documenting Process Calibrators

Service Manual

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Chapter 1
Introduction and Specifications

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Introduction	1-3
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Introduction

Fluke 701 and 702 Documenting Process Calibrators (hereafter referred to as the calibrator) are battery-powered, hand-held instruments that measure and source electrical and physical parameters. The calibrator lets you troubleshoot, calibrate, verify, and document the calibration of process instruments. See the end of this chapter for complete specifications.

Unless stated otherwise, everything in this manual applies to both the Fluke 701 and 702 Documenting Process Calibrators. This manual contains maintenance, repair, verification testing, and calibration instructions. In addition, it provides an illustrated list of replaceable parts and schematic diagrams.

The phone number in the USA and Canada for replacement parts is: 1-800-526-4731. For application or operation assistance on Fluke products, call:

- 800-44-FLUKE (800-443-5853) in USA and Canada
- (31 40) 267 8200 in Europe
- (206) 356-5500 from other countries

Safety Information

This calibrator is designed and tested in accordance with IEC1010-1. Use the calibrator only as specified in this manual, the *Users Manual*, or in the *Quick Reference Guide*; otherwise the protection provided by the calibrator may be impaired.

A WARNING identifies conditions and actions that pose hazards to the user; a CAUTION identifies conditions and actions that may damage the calibrator or the equipment under test.

Symbols used on the calibrator and in this manual are explained in Figure

~	AC-Alternating Current	⚠	CAUTION see explanation in manual
⎓	DC-Direct Current	⏚	Common (LO) Input equipotentiality
⏛	Fuse	⏻	ON/OFF
	Pressure	⧈	Equipment protected throughout by DOUBLE INSULATION or REINFORCED INSULATION
Ni-Cd	Recycling	CAT II	Overvoltage (Installation) Category II per IEC 1010-1 refers to the level of Impluse Withstand Voltage protection provided. Typical locations include; Mains Wall outlets, local appliances and PORTABLE EQUIPMENT.

dw1f.eps

Figure 1-1. Definition of Symbols

To protect yourself, follow these safety guidelines:

- Do not use the calibrator if it is damaged. Before you use the calibrator, inspect the insulating cover. Look for cracks or missing plastic. Pay particular attention to the insulation surrounding the connectors.
- Disconnect the power and discharge all high-voltage capacitors in the equipment under test before testing resistance or continuity.
- Inspect the test leads for damaged insulation or exposed metal. Check test lead continuity. Replace damaged test leads before using the calibrator.
- Do not use the calibrator if it operates abnormally. Protection may be impaired. When in doubt, have the calibrator serviced.
- Select the proper function and range for your measurement.
- Use caution when working above 42V pk, 30V ac rms, or 60V dc. Such voltages pose a shock hazard.
- When using the probes, keep your fingers away from the probe contacts. Keep your fingers behind the finger guards on the probes.
- Connect the common test lead before you connect the live test lead. When you disconnect test leads, disconnect the live test lead first.
- Do not operate the calibrator around explosive gas, vapor, or dust. When using a pressure module, make sure the process pressure line is shut off and depressurized before you connect it to the pressure module.
- Disconnect test leads before changing to another measure or source function.
- When servicing the calibrator, use only specified replacement parts.

Specifications

All specifications apply from +18°C to +28°C unless stated otherwise.

All specifications assume a 5 minute warmup period.

Measurement specifications are valid only when damping is turned on. When damping is turned off, or when the ~ annunciator is displayed, floor specifications are multiplied by 3. Floor specifications are the second part of the specifications, usually expressed as "% of full scale." The measure pressure, temperature, and frequency functions are specified only with damping on.

The standard specification intervals for the 701 and 702 are 1 and 2 years. Typical 90-day source and measurement accuracy can be estimated by dividing the 1 year "% OF READING" or "% OF OUTPUT" specifications by 2. Floor specifications, expressed as "% OF FULL SCALE," remain constant.

Note

To achieve best voltage measurement noise and accuracy performance, do not use the battery eliminator, and tie all three common jacks together (for DC and AC measure functions only).

DC Voltage Measurement

Range	Resolution	Model 702 % of Reading + % of Full Scale		Model 701 % of Reading + % of Full Scale	
		1 Year	2 Years	1 Year	2 Years
110 mV	1 µV	0.025% + 0.015%	0.05% + 0.015%	0.05% + 0.015%	0.1% + 0.015%
1.1V	10 µV	0.025% + 0.005%	0.05% + 0.005%	0.05% + 0.005%	0.1% + 0.005%
11V	100 µV	0.025% + 0.005%	0.05% + 0.005%	0.05% + 0.005%	0.1% + 0.005%
110V	1 mV	0.05% + 0.005%	0.1% + 0.005%	0.05% + 0.005%	0.1% + 0.005%
300V	10 mV	0.05% + 0.005%	0.1% + 0.005%	0.05% + 0.005%	0.1% + 0.005%

Temperature Coefficient: (0.001% of rdg. + 0.0015% f.s.)/°C in the ranges 0 to 18°C and 28 to 50°C
Input Impedance: 5 MΩ
Common Mode Error: 0.008% f.s./(Common Mode Volt)
Maximum Input Voltage: 300V rms

AC Voltage Measurement

Frequency Range	Model 701 And 702 (% Of Reading + Number Of Counts)	
	1 Year	2 Years
20 to 40 Hz	2% + 10	2% + 10
40 to 500 Hz	0.5% + 5	0.5% + 5
500 Hz to 1 kHz	2% + 10	2% + 10
1 kHz to 5 kHz	10% + 20	10% + 20

Specifications apply for 10% to 100% of voltage range.
Ranges : 1.1000V, 11.000V, 110.00V, 300.0V rms
Resolution: 11,000 counts in all ranges except 300V; 3,000 counts on 300V range.
Input Impedance: 5 MΩ and <100 pF
Temperature Coefficient: 10% of spec/°C in the ranges 0 to 18°C and 28 to 50°C
Input Coupling: ac
Maximum Input Voltage: 300V rms
For frequencies >1 kHz, the minimum voltage is 0.5V

DC Current Measurement

Range	Resolution	Model 702 % of Reading +% of Full Scale		Model 701 % of Reading +% of Full Scale	
		1 Year	2 Years	1 Year	2 Years
30 mA	1 µA	0.025% + 0.025%	0.025% + 0.03%	0.025% +0.025%	0.025% + 0.03%
110 mA	10 µA	0.05% + 0.05%	0.07% + 0.07%	0.05% + 0.05%	0.1% + 0.07%

Temperature Coefficient: (0.001% of rdg. + 0.002% f.s.)/°C in the ranges 0 to 18°C and 28 to 50°C
Common Mode Error: 0.01% f.s./(Common Mode Volt)
Maximum Input Voltage: 30V dc

Resistance Measurement

Range	Resolution	Model 702 % of Reading + Ohms		Model 701 % of Reading + Ohms	
		1 Year	2 Years	1 Year	2 Years
11Ω	0.001Ω	0.05% + 0.05	0.075% + 0.05	0.1% + 0.05	0.15% + 0.05
110Ω	0.01Ω	0.05% + 0.05	0.075% + 0.05	0.1% + 0.05	0.15% + 0.05
1.1 kΩ	0.1Ω	0.05% + 0.5	0.075% + 0.5	0.1% + 0.5	0.15% + 0.5
11 kΩ	1Ω	0.1% + 10	0.1% + 10	0.1% + 10	0.15% + 10

Temperature Coefficient: (0.01% f.s. + 2 mΩ) /°C in the ranges 0 to 18°C and 28 to 50°C
Common Mode Error: 0.005% f.s/(Common Mode Volt)
Maximum Input Voltage: 30V dc

Continuity Testing

Tone	Resistance
Continuous Tone	<25 Ω
May or may not get tone	25 to 400 Ω
No tone	>400 Ω

Frequency Measurement

Ranges	Model 701 and 702 Counts	
	1 Year	2 Years
1.00 Hz to 109.99 Hz	5	5
110.00 Hz to 1099.9 Hz	5	5
1.100 kHz to 10.999 kHz	5	5
11.00 kHz to 50.00 kHz	5	5

Amplitude range for frequency measurement (square wave): **1 Hz to <1 kHz:** 110 mV to 300V rms
1 kHz to 30 kHz: 0.5 to 30V rms
>30 kHz to 50 kHz: 1V to 30V rms

Input Impedance: 5 MΩ

For frequency measurement less than 109.99 Hz, specification applies for signals with a slew rate greater than 5 Volt/millisecond.

*DC Voltage Output**

Range	Resolution	Model 702 % Output + % of Full Scale		Model 701 % Output + % of Full Scale	
		1 Year	2 Years	1 Year	2 Years
110 mV	1 μV	0.01% + 0.005%	0.015% + 0.005%	0.015% + 0.005%	0.02% + 0.005%
1.1V	10 μV	0.01% + 0.005%	0.015% + 0.005%	0.015% + 0.005%	0.02% + 0.005%
11V	100 μV	0.01% + 0.005%	0.015% + 0.005%	0.015% + 0.005%	0.02% + 0.005%

Temperature Coefficient: (0.001% OUTPUT + 0.001% of f.s.)/°C in the ranges 0 to 18°C and 28 to 50°C
Maximum Output Current: 10 mA
Loading: (0.001% f.s. + 1 uV)/ mA
Common Mode Error: 0.008% f.s/(Common Mode Volt)
Maximum Input Voltage: 30V dc

*For instruments with firmware version 1.3 or higher.

DC Current Output

Range	Resolution	Models 702 And 701 % Of Output +% Of Full Scale	
		1 Year	2 Years
22 mA	1 µA	0.01% + 0.04%	0.02% + 0.06%

Maximum Burden Voltage: 24V
Temperature Coefficient: (0.003% OUTPUT + 0.003% of f.s.)/°C in the ranges 0 to 18°C and 28 to 50°C
Common Mode Error: 0.008% f.s/(Common Mode Volt)
Maximum Input Voltage: 30V dc

Specification applies for currents between 2 mA and 22 mA. For current below 2 mA, typical accuracy is 0.15% of full scale.

*Resistance Sourcing**

Ranges	Resolution	Model 702 % of Output + Ohms		Model 701 % of Output + Ohms	
		1 Year	2 Years	1 Year	2 Years
11Ω	1 mΩ	0.01% + 0.02	0.02% + 0.02	0.02% + 0.02	0.03% + 0.02
110Ω	10 mΩ	0.01% + 0.04	0.02% + 0.04	0.02% + 0.04	0.03% + 0.04
1.1 kΩ	100 mΩ	0.02% + 0.5	0.03% + 0.5	0.05% + 0.5	0.1% + 0.5
11 kΩ	1Ω	0.3% + 5	0.04% + 5	0.1% + 5	0.15% + 5

Temperature Coefficient: (0.01% of f.s.)/°C in the ranges 0 to 18°C and 28 to 50°C
Maximum/Minimum Current through Source Resistance:
11W Range: 3 mA max, 0.1 mA min
110W Range: 3 mA max, 0.1 mA min
1.1 kW Range: 3 mA max, 0.01 mA min
11 kW Range: 0.1 mA, 0.01 mA min
Common Mode Error: 0.008% f.s/(Common Mode Volt)
Maximum Input Voltage: 30V dc

*For instruments with firmware version 1.3 or higher.

Frequency Sourcing

Frequency Ranges	Models 702 and 701, 1 Year and 2 Year Counts
2.00 Hz to 109.99 Hz	1
110 Hz to 1099 Hz	1
1.1 kHz to 10.9 kHz	1
11 kHz to 50 kHz	2

Waveform: Squarewave, 50% duty cycle
Amplitude: 0 to 10V pk
Amplitude Accuracy:
2 to 109.99 Hz: 3% OUTPUT + 0.05V
110 to 1099 Hz: 3% OUTPUT + 0.05V
1.1 to 10.9 kHz: 10% OUTPUT + 0.05V
11 to 50 kHz: 30% OUTPUT + 0.05V
Maximum Input Voltage: 30V dc

Temperature, Thermocouples

Types (°C)	Models 702 and 701 (°C)			
	Measure		Source	
	1 Year	2 Years	1 Year	2 Years
E				
-250 to -200	1.3	2.0	0.6	0.9
-200 to -100	0.5	0.8	0.3	0.4
-100 to 600	0.3	0.4	0.3	0.4
600 to 1000	0.4	0.6	0.2	0.3
N				
-200 to -100	1.0	1.5	0.6	0.9
-100 to 900	0.5	0.8	0.5	0.8
900 to 1300	0.6	0.9	0.3	0.4
J				
-210 to -100	0.6	0.9	0.3	0.4
-100 to 800	0.3	0.4	0.2	0.3
800 to 1200	0.5	0.8	0.2	0..3
L*				
-200 to -100	0.6	0.9	0.3	0.4
-100 to 800	0.3	0.4	0.2	0.3
800 to 900	0.5	0.8	0.2	0.3
K				
-200 to -100	0.7	1.0	0.4	0.6
-100 to 400	0.3	0.4	0.3	0.4
400 to 1200	0.5	0.8	0.3	0.4
1200 to 1372	0.7	1.0	0.3	0.4
T				
-250 to -200	1.7	2.5	0.9	1.4
-200 to 0	0.6	0.9	0.4	0.6
0 to 400	0.3	0.4	0.3	0.4
U*				
-200 to 0	0.6	0.9	0.4	0.6
0 to 600	0.3	0.4	0.3	0.4

Temperature, Thermocouples (cont)

Types (°C)	Models 702 and 701 (°C)			
	Measure		Source	
	1 Year	2 Years	1 Year	2 Years
B				
600 to 800	1.3	2.0	1.0	1.5
800 to 1000	1.0	1.5	0.8	1.2
1000 to 1820	0.9	1.3	0.8	1.2
R				
-20 to 0	2.3	2.8	1.2	1.8
0 to 100	1.5	2.2	1.1	1.7
100 to 1767	1.0	1.5	0.9	1.4
S				
-20 to 0	2.3	2.8	1.2	1.8
0 to 200	1.5	2.1	1.1	1.7
200 to 1400	0.9	1.4	0.9	1.4
1400 to 1767	1.1	1.7	1.0	1.5
C				
0 to 800	0.6	0.9	0.6	0.9
800 to 1200	0.8	1.2	0.7	1.0
1200 to 1800	1.1	1.6	0.9	1.4
1800 to 2316	2.0	3.0	1.7	2.0

Sensor inaccuracies not included
Resolution: 0.1°C
Temperature Scale: ITS-90 or IPTS-68, selectable
Compensation: ITS-90 per NIST Monograph 175 for R, S, B, J, T, E, K, and N thermocouples; IPTS-68 per IEC 584-1 for R, S, B, J, T, E, K, E, and K thermocouples; IPTS-68, per NIST Monograph 161 for N thermocouples.
Temperature Coefficient: 0.05°C/°C in the ranges 0 to 18°C and 28 to 50°C
Common Mode Error: 0.01°C/(Common Mode Volt)
Maximum Input Voltage: 30V

*For instruments with firmware version 1.3 or higher.

Temperature, Resistance Temperature Detectors (RTDs)

Types (°C)	Models 702 and 701 ±°C			
	Measure		Source	
	1 Year	2 Years	1 year	2 Years
100Ω Pt(385)				
-200 to 0	0.3	0.5	0.1	0.2
0 to 400	0.5	0.8	0.2	0.4
400 to 800	0.8	1.0	0.4	0.5
100Ω Pt(3926)				
-200 to 0	0.3	0.4	0.1	0.2
0 to 630	0.5	0.8	0.2	0.4
120Ω Ni(672)				
-80 to 0	0.3	0.4	0.1	0.2
0 to +260	0.3	0.4	0.1	0.2
10Ω Cu(427)*				
-100 to 0	2	2	1	1
0 to 260	2	2	1	1
100Ω Pt(3916)*				
-200 to -190	0.3	0.4	0.3	0.4
-190 to 0	0.3	0.4	0.1	0.2
0 to 630	0.5	0.8	0.2	0.4
200, 500, 1000Ω Pt(385)*				
-200 to 0	0.3	0.5	0.1	0.2
0 to 400	0.5	0.8	0.2	0.4
400 to 630	0.8	1	0.4	0.5

Accuracy with external cold junction; for internal cold junction add 0.2°C
Sensor inaccuracies not included
Resolution: 0.1°C
Temperature Coefficient: 0.02°C/°C in the ranges 0 to 18°C and 28 to 50°C
Maximum Input Voltage: 30V
Maximum Input Current for RTD Source Fuction:
10Ω RTD: 3 mA dc
100Ω, 120Ω RTDs: 3 mA dc
200Ω, 500Ω, 1000Ω RTDs: 3 mA dc
1000Ω RTD: 0.2 mA dc
For two and three-wire RTD measurements, add 0.4°C to the specifications.

*For instruments with firmware version 1.3 or higher.

Loop Power Supply

Setting	Models 702 and 701, 1 Year and 2 Years
24 Volt	5%
28 Volt	5%
Short circuit protected **Maximum Current:** 22 mA **Maximum Input Voltage:** 30V dc	

Top and Bottom Limits of Ranges with Auto Range On

Range, DCV Measure	Top of Range	Bottom of Range
110 mV	±110.000 mV	0.000 mV
1.1V	±1.10000V	±0.10000V
11V	±11.0000V	±1.0000V
110V	±110.000V	±10.000V
300V	±300.00V	±100.00V
Range, DCV Source		
110 mV	+110.000 mV	-10.000 mV
1.1V	+1.10000V	+0.10000V
11V	+11.000V	+1.1000V
Range, Ohms Measure and Source		
11Ω	11.000Ω	0.000Ω
110Ω	110.00Ω	10.00Ω
1.1 kΩ	1100.0Ω	100.0Ω
11 kΩ	11.000 kΩ	1.000 kΩ
Range, Current Measure		
22 mA	+22.000 mA	0.000 mA
Range, Measure AC V		
110 mA	+110.00 mA	+30.00 mA
Range, Current Source		
22 mA	+30.000 mA	0.000 mA
Range, Frequency Measure		
100 Hz	109.99 Hz	1.00 Hz
1 kHz	1099.9 Hz	100.00 Hz
10 kHz	10.999 kHz	1.000 kHz
50 kHz	50.00 kHz	10.00 kHz

General Specifications

Display:	240 by 200 pixel graphic LCD, 70 x 58 mm.
Power:	Internal Battery Pack: NiCd, 7.2V, 1700 mAhr.
Memory Backup:	Lithium battery, 5 years typical lifetime.
Dimensions:	130 x 236 x 61 mm (5.1 x 9.3 x 2.4 in.).
Weight:	1.4 kg (3 lb. 1 oz.).
Altitude:	Up to 2000 meters above mean sea level.
Environmental:	0 to 50°C (operating).
Temperature:	-20 to 60°C (storage).
Humidity:	Avoid prolonged use outside the safe operating boundaries shown in Figure
Water/Dust Protection:	Designed to meet IEC529 IP52 (normal operating vacuum used for dust test).
Storage:	Storage of the unit creates no problems; therefore, no instructions are offered.
Safety:	Designed in accordance with IEC 1010-1, ANSI/ISA-S82, UL1244, and CSA C22.2 #231. See Safety Information in this manual.
Warranty:	See the WARRANTY, back of Title Page.

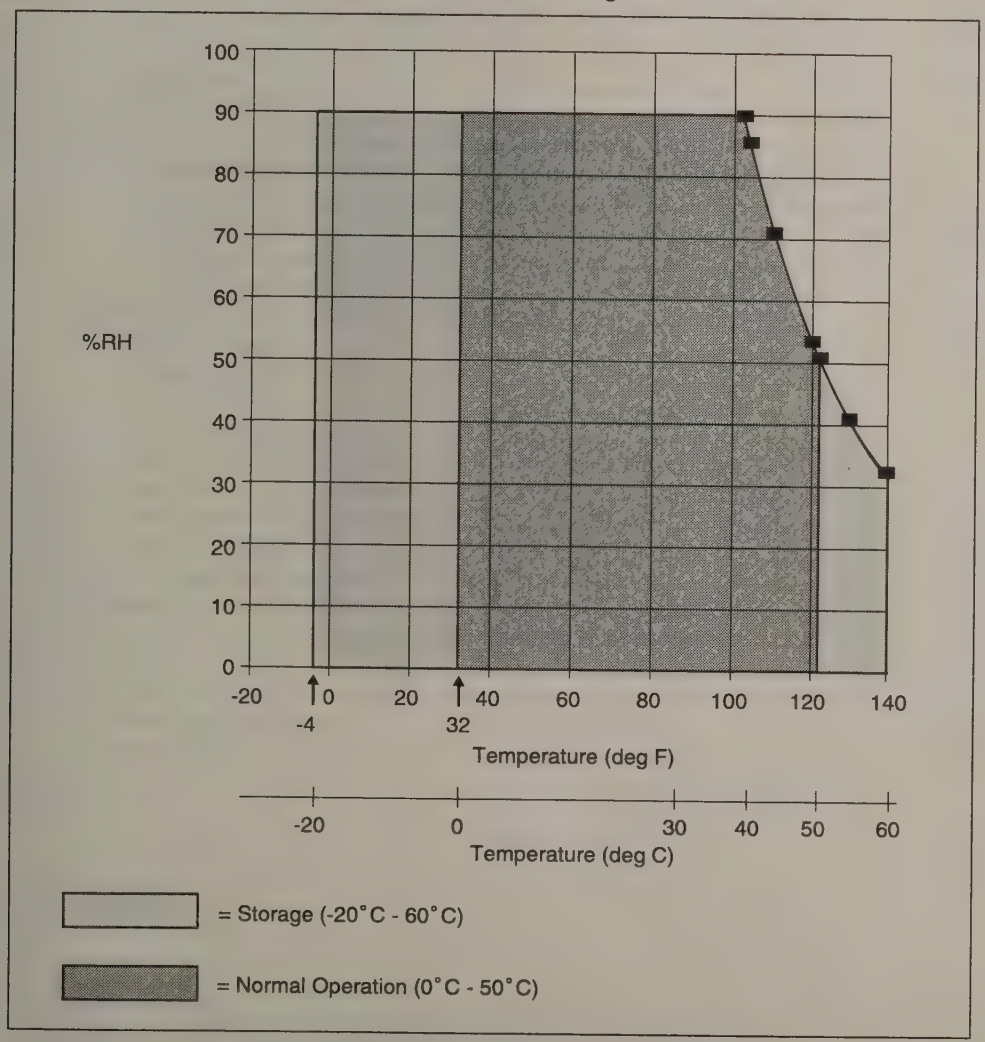

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Figure 1-2. LCD Operating Environment Specification

Chapter 2
Theory of Operation

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Introduction

Chapter 2 describes the function of the Fluke 701 and 702 Documenting Process Calibrators (hereafter referred to as the calibrator). The theory of operation provides sufficient information for a service technician to identify which of the two internal assemblies is at fault in case of a malfunction, but it does not provide all the component level details.

Model 702 has different internal software, improved specifications in some of the functions, and a serial connector on the side for communicating with a PC. Otherwise, the two models are the same.

The calibrator operates in three major modes: measurement, source, and simultaneous measure/source. The areas of circuitry in the main circuit assembly are identified in Figure 2-1. Chapter 2 describes the calibrator first from the binding post perspective, then describes source mode, measure mode, and finally the power supply. It would be helpful to refer to the schematic diagrams and assembly drawings when studying the text in this chapter.

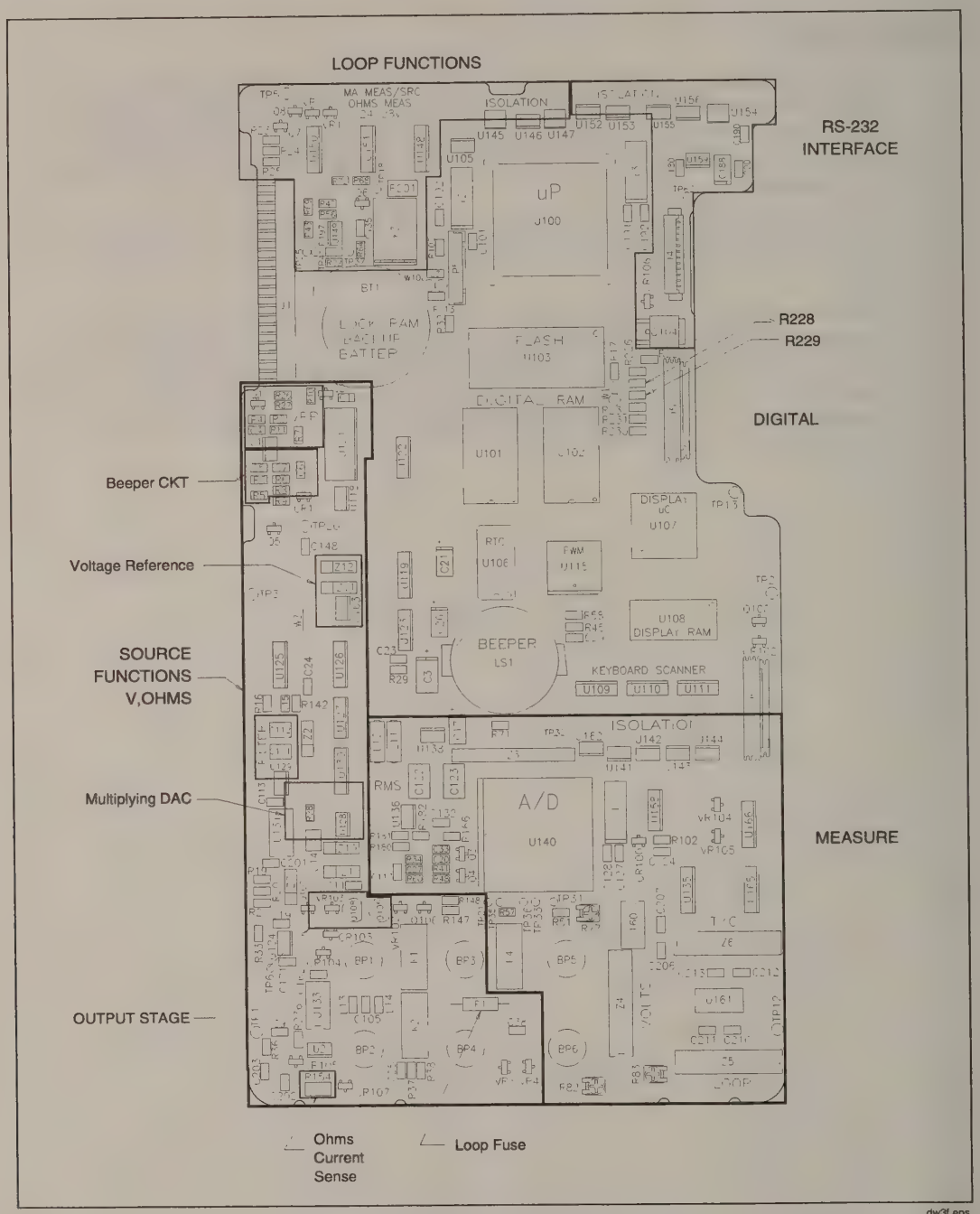

Figure 2-1. Main Printed Circuit Assembly

Input and Output Jacks

There are four sets of input/output jacks as follows:

1. Loop power, source volts, ohms, RTD, and frequency.
2. Source mA, measure mA, ohms and RTD.
3. Measure volts and frequency.
4. TC (thermocouple) measure and source.

The calibrator also has a pressure module connector, allowing pressure measurements when the [Ω] key is selected. When pressure is not selected on the calibrator, the power to the pressure module is internally switched off to minimizing power drain on the battery.

Model 702 has a 9-pin serial port. The serial port allows for two-way communication between the calibrator and a personal computer. The serial port is designed to be used with PMLink software running on an IBM PC or compatible.

The serial port, pressure port and all input and output jacks are electrically isolated from each other. Electrical isolation means that the impedance between the isolated circuits is extremely high but not infinite. Electrical isolation provides immunity from common mode effects and ground loop influences. As an example, added error would result when sourcing an RTD and measuring a current (for 4 to 20 mA loop) if the grounds were not isolated.

Source Mode: Volts, Ohms, RTD, and Frequency

The output jacks identified as V, Ω, and RTD provides these three source functions. These output jacks are also used as a frequency source. Voltage outputs are available from -10 mV to 11V. Resistance values are available from 0Ω to 11 kΩ. The circuit that sources both volts and resistance uses a pulse-width modulation (PWM) technique.

Generating an Accurate DC Voltage Using Pulse Width Modulation

PWM is a technique where a precision reference is accurately switched at a constant frequency (in this case 1 kHz using U115, U112 and FET switches U130) into a low pass filter (three pole filter, U129, C111, C112, C115, R137, R139, and R140). The duty cycle of the frequency determines the dc voltage after the filter removes the ac components.

Duty cycle is controlled by a 10 MHz quartz crystal (Y3), a divide-by-two counter (U120, which produces 5 MHz output labeled as CLK5MHZ), and a 16-bit timer (U115). A 12-bit multiplying digital to analog converter (MDAC, U128, and amplifier U129) is used as a second channel to provide added resolution to the source functions.

The overall resolution for the PWM is approximately 24 bits. The reference for the PWM is generated from a precision 7V reference (U163), which is attenuated to 1.4V by a proprietary precision resistor divider (Z11 and Z12).

Generating an Accurate Ohms Source Using Pulse Width Modulation

To measure resistance, an externally supplied current must exist at the input jacks to create a voltage to be measured. This current would normally be supplied by an ohmmeter or some other energized circuit that is connected to the calibrator. If a current is not applied, then a voltage is not developed across the internal reference resistor (R154), and a reference voltage will not be created for the PWM.

In order to synthesize different resistance values, the PWM uses the voltage generated from the applied current as a reference, then proportionally adjusts and channels a voltage to the output to simulate a resistance. The reference for the PWM is generated by amplifier U133, providing a virtual ground, causing the input current to flow through precision resistor R154. Switch U125 disables the 7V reference that is used for dc voltage sourcing.

Sourcing RTDs

There is no hardware difference between resistance source operation and the RTD (Resistance Temperature Detector) source operation. Software determines the correct resistance value to simulate various types of RTDs.

Sourcing Frequency

Frequency generation uses the MDAC (U128 and U129) as a variable voltage source for amplitude control, combined with a 50% duty cycle square wave to produce the frequency source at the output. The frequency is obtained by using a counter in the microprocessor chip (U100). A square waveform obtained from the microprocessor switches the reference voltage from the MDAC (via U127 and U126) into the output amplifier (U133, Q105, and Q108) to produce an accurately controlled frequency and amplitude waveform at the output jacks.

Output Amplifier

The output amplifier for dc volts, resistance, RTD, and frequency is the same. The amplifier (U133) is designed to handle applied voltages of 30V without damage. The output amplifier can deliver 10 mA of current and has a foldback current limit (Q106, Q107, VR102, and VR103), which is triggered for current between 12 to 15 mA. When the foldback current limit is triggered, the current drops down to about 4 mA and remains at that level until the load is removed entirely.

Sourcing mA, Measuring mA, Ohms and RTD

The mA (center) jacks provide both current source and current measure capability, ohms measurements, and two-wire, three-wire, and four-wire RTD measurements.

When you source current, you can select the simulate transmitter function. In the simulate transmitter function, the calibrator acts as a variable load, continually making adjustments to match the value of the current selected.

You cannot use the Loop Power function at the same time as the simulate transmitter function. You can, however, use the Loop Power function and the measure mA function simultaneously.

It is important to remember that the mA jacks are electrically isolated from the other input and output jacks, providing enhanced performance for simultaneously using a measurement and source function.

Sourcing mA

When first observed, the source mA function often appears as the most complex of the calibrator functions. However, the basic concept is quite simple. Selection of the source mA function initiates several steps.

First, a dc voltage is produced using PWM. This PWM approach for creating an accurate dc source is identical to the approach under the heading "Generating an Accurate DC Voltage Using Pulse Width Modulation."

The circuitry that derives the PWM voltage consists of the following:

- 1 kHz output waveform at U115 identified as LOOP_PWM.
- Optical coupler U3 (which provides electrical isolation for the mA function).
- Two FET switches contained within U150.
- Summing amplifier U149.
- Two-pole filter stage identified by components R22, C22, R42, and C28.

The filtered dc output voltage of the PWM DAC appears at TP4, the input to the error amp (U149). The feedback to the error amp is the voltage across the current sense resistor (R205), so the resulting output current is the DAC voltage divided by the current sense resistance. The output of the error amp (LOOP_CTRL) controls the current produced by the output stage (Q5, Q8, Q9, and associated circuitry located on the Power Supply PCA.

Accuracy is obtained using the following circuit elements:

- A precision resistor (either R202, a 10Ω resistor, or R201, a 1 kΩ resistor, depending on the range and function selected).
- Instrumentation/isolation amplifier (U161 and precision Fluke network Z5).
- An accurate analog-to-digital converter (A/D, Fluke integrated circuit U140).
- A microprocessor (U100) and software algorithms that adjust the current to the desired tolerance level.

When current flows through the precision resistor, the instrumentation amplifier measures the resulting voltage and supplies the result to the A/D via a analog switches U165 and U151. Once the voltage is determined by the A/D, the information is digitally transferred to the microprocessor through optical couplers (U141, U142, U143, U144, and U162) to provide isolation.

Because of previous calibrations, the microprocessor understands the relationship between the desired source current and the voltage measured by the A/D and the PWM voltage that must be controlled to produce the desired current. If the current is not within the value tolerance level set by the microprocessor, an adjustment to the PWM voltage occurs, which in turn shifts the current in the mA output jack. The amount that the current changes is reflected by the voltage change across the precision resistor, which is monitored by the instrumentation amplifier and A/D, and the entire controlled measurement and adjustment sequence is re-initiated. Therefore, source mA is in reality an internal measurement sequence as seen by the calibrator.

Measuring mA

Measure mA is a subfunction of source mA. During measure mA, the same precision resistor is used (R202, a 10Ω resistor); however, the PWM control voltage is set to zero. When current is injected into the mA jacks, a voltage is developed across precision resistor R202. The voltage is monitored by the same instrumentation/isolation amplifier (U161). The output of the instrumentation amplifier is measured by the A/D (U140), where the information is transferred to the microprocessor, which then transfers the information to the display to indicate the measured current as seen at the mA input jacks.

Loop Power

The same circuit that sources mA can also be configured to provide either +24 or +28V dc for supporting a 4-20 mA current loop. The loop power feature is turned on and off in the Setup menu. The LOOP OUTPUT node is set according to the Setup menu setting. When Loop Power is turned on, the middle jacks not only supply the voltage power for the loop, but can also simultaneously measure the current through the loop with the measure mA function.

Measuring Resistance

Resistance measurements are based on the relationship of Ohm's Law. The calibrator supplies a known current and measures the voltage across the unknown applied resistance and the reference resistor R201. Measure resistance is the most complex of all of the measurement sequences in the calibrator. In addition to all the things that need to happen to source mA, additional voltage measurements must occur to decipher the value of the unknown resistance applied to the input. The process is the same for RTD measure, except that software converts ohms measurements to display in equivalent °F or °C.

All ohms and RTD measurements use the source mA jacks. Therefore, for ohms and RTD measurements, the calibrator uses the mA jacks to supply the necessary current to allow measurement of the ohms and RTD functions.

Depending on the type of resistance measurement, whether ohms, or two-, three-, or four-wire RTD, the primary difference is simply where the unknown voltage is measured from the applied resistance. For four-wire RTD measurements, the input voltage from the unknown resistance is measured at the V measure jacks. For three-wire RTD measurements, a sequence of measurements occurs between the V measure input and the mA measure jacks. During three-wire RTD measurements, several voltage measurement occur. The resistance of the leads is measured and compensated for, and the voltage across the applied resistance is measured. The final displayed result removes the error of the leads based on measuring only one set of leads. It is assumed that the other set of lead exactly matches the measured set. Two-wire RTD and resistance measurements use only the mA jacks.

Simulating a Transmitter

Simulate transmitter is a derivative of the source mA function. During simulate transmitter, a voltage must be supplied externally (you cannot use the calibrator's Loop Power function at the same time as the simulate transmitter function).

A sequence similar to the source mA operation occurs. After you request the desired current, the calibrator forces the resistance at the binding posts to adjust itself to the required resistance value to control the current to the desired level. The resistance is continually adjusted by the calibrator if there are fluctuations of the supply current. Note that if the supply voltage changes, the resistance established by the calibrator to produce the desired current will change.

From a troubleshooting standpoint, the important thing is that this function is the same as mA source, except the current goes the opposite direction, so the DAC voltage is inverted.

mA Overvoltage Protection

The mA functions will not be damaged if voltages up to 30V are applied. If you apply excessive voltage, the mA jacks are fused with a fast blow 0.5A fuse (F1 near the mA binding posts). However, if sufficient power is applied to the input, circuitry can still be damaged. You are advised to use caution when applying voltage to the mA jacks.

Measuring Volts and Frequency

Voltage and frequency measurements use the volts measure input jacks (right side jacks). The calibrator can measure up to ±300V or 300V rms. The calibrator measures frequency up to 50 kHz. The lowest range is the 110 mV range and has a 1 uV resolution. A total of five ranges are available and the calibrator can automatically select the best range. The volts measure input jacks are electrically isolated from all other inputs. The input impedance of the volts measure function is 5 MΩ.

Measuring DC Volts

During dc volts measure, the applied input voltage is monitored using an instrumentation amplifier (U160) and a thin film precision network (Z4). Also, to minimize 60 Hz common mode pickup, the impedance of the network Z4 is balanced or matched to maximize common mode rejection performance. Quad switch U135 performs ranging for U160. The input is divided by 3.6, 36, or 300. The voltage at the output of the amplifier (U160) is switched via U165 to the A/D input (U140) where the measured signal is digitized and transferred to the microprocessor through optical couplers (U141 through U144). During all A/D measurements, the common mode error of the amplifier is monitored to further reduce and improve the common mode rejection of the overall circuit.

Measuring Frequency and AC Voltage

When an ac voltage is applied to the voltage measure jacks, both frequency and rms ac voltage measurements are obtained. The ac voltage is first divided, then measured using a root-mean square (rms) calculating converter (U137). Maximum input into U137 is 300 mV. During ac voltage measurement, the frequency is also measured using the internal counter of the A/D. Amplitude errors caused by bandwith limitations can be compensated with the calibrator knowing the frequency of the applied signal. After the frequency has been determined, corrections are made to the measured ac voltage, helping to eliminate errors associated with the input amplifier and the high impedance input resistor network.

Measuring and Simulating Thermocouples

The thermocouple jacks use a special polarized mini-connector. During the simulate thermocouple function, a voltage from the source voltage circuitry (U133) is applied to the thermocouple jacks via relay K1. When you request a temperature, a software algorithm determines the proper voltage to be applied to the TC output. Located next to the thermally matched TC jacks is a thermistor (RT2) that is used for cold junction corrections. The thermistor is continually monitored by the A/D to allow for temperature corrections at the TC output jacks.

Thermocouple measurement uses the same technique as voltage measurement. However, the measurement occurs through a separate instrumentation amplifier so that proper isolation can be achieved between the different source and measurement circuits of the calibrator.

During TC measurements, the applied voltage from the thermocouple is measured by an instrumentation amplifier (U161 and Z6). The output of this amplifier is then switched (U165) into the A/D (U140). Concurrently, the common mode errors of the amplifier are measured and the thermocouple is continually checked to identify an open thermocouple condition. Last, the cold junction temperature is determined by monitoring thermistor RT2.

Analog-to-Digital Converter (A/D) Used for Volt Measure

The A/D (U140) is a Fluke-designed integrated circuit that uses dual-slope integration A/D conversion and provides signal conditioning and ranging. Using this type of design helps reduce amplifier and system noise since the noise is averaged or integrated during the capacitor integration time. Also integrated into the A/D are a variety of high performance switches used to switch a variety of signals throughout the chip. An added benefit of the A/D is an internal counter used for frequency measurements. The A/D uses an external 7V reference (U164). To further reduce ac noise effects during all dc measurements, a three-pole low-pass filter (U160 and associated resistors and capacitors) is switched into the measurement path during the measurement sequence.

Pressure

Pressure can only be measured by using Fluke accessory pressure modules. A pressure source function for calibrating pressure-to-current transducers can be achieved by using an external pressure source. Pressure modules are available in the following eight ranges:

- Model 700P01 10 inH_20 Differential Pressure
- Model 700P02 1 psi Differential Pressure
- Model 700P03 5 psi Differential Pressure
- Model 700P04 15 psi Differential Pressure
- Model 700P05 30 psi Gage Pressure
- Model 700P06 100 psi Gage Pressure
- Model 700P07 500 psi Gage Pressure
- Model 700P08 1000 psi Gage Pressure

Pressure modules are connected into the side connector of a calibrator. The calibrator does not apply power to a pressure module until you select either pressure source or pressure measurements. Communication between a calibrator and a pressure module occurs using a RS-232 protocol. Each pressure module contains all the required analog circuitry, microprocessor E^2PROM, and calibration constants to allow complete pressure measurement after which the digitized information is downloaded into the calibrator for display. The pressure module transfers digital information to the calibrator through optocouplers (U152 through 156) to the microprocessor.

Serial Interface Connector (702 Only)

Model 702 has a 9-pin RS-232 connector (P4) for connecting to an external computer. Optocouplers U152 through U156 isolate the communication link.

Power Supply Assembly

The calibrator is normally powered using the supplied battery. However, for bench operation, the calibrator can be powered using the battery eliminator. Greater measurement accuracy is attained without the use of the battery eliminator. When the battery eliminator jack is used, the internal battery is disconnected from the internal circuitry of the calibrator. The main battery cannot be recharged while it is installed in the calibrator. The battery can only be charged in the external charger.

There are a variety of regulated supplies that are generated on the Power Supply assembly. Figure 2-2 shows the locations of various power supplies on the Power Supply assembly. Several of the supplies are electrically isolated to allow improved performance during simultaneous operation of source and measurement functions. FETs Q2 and Q3 serve as an electronic off/on switch. Amp U7 turns on the display backlight, while buffer/amp U8 controls the display contrast. U3 indicates Low Battery operation and U7 turns off the calibrator.

Also located on the Power Supply is the transconductance amplifier circuitry that is used for sourcing mA (Q5, Q8, and Q9).

Table 2-1 identifies the various supplies generated on the power supply assembly, the voltage of the supply, and the function that uses the supply.

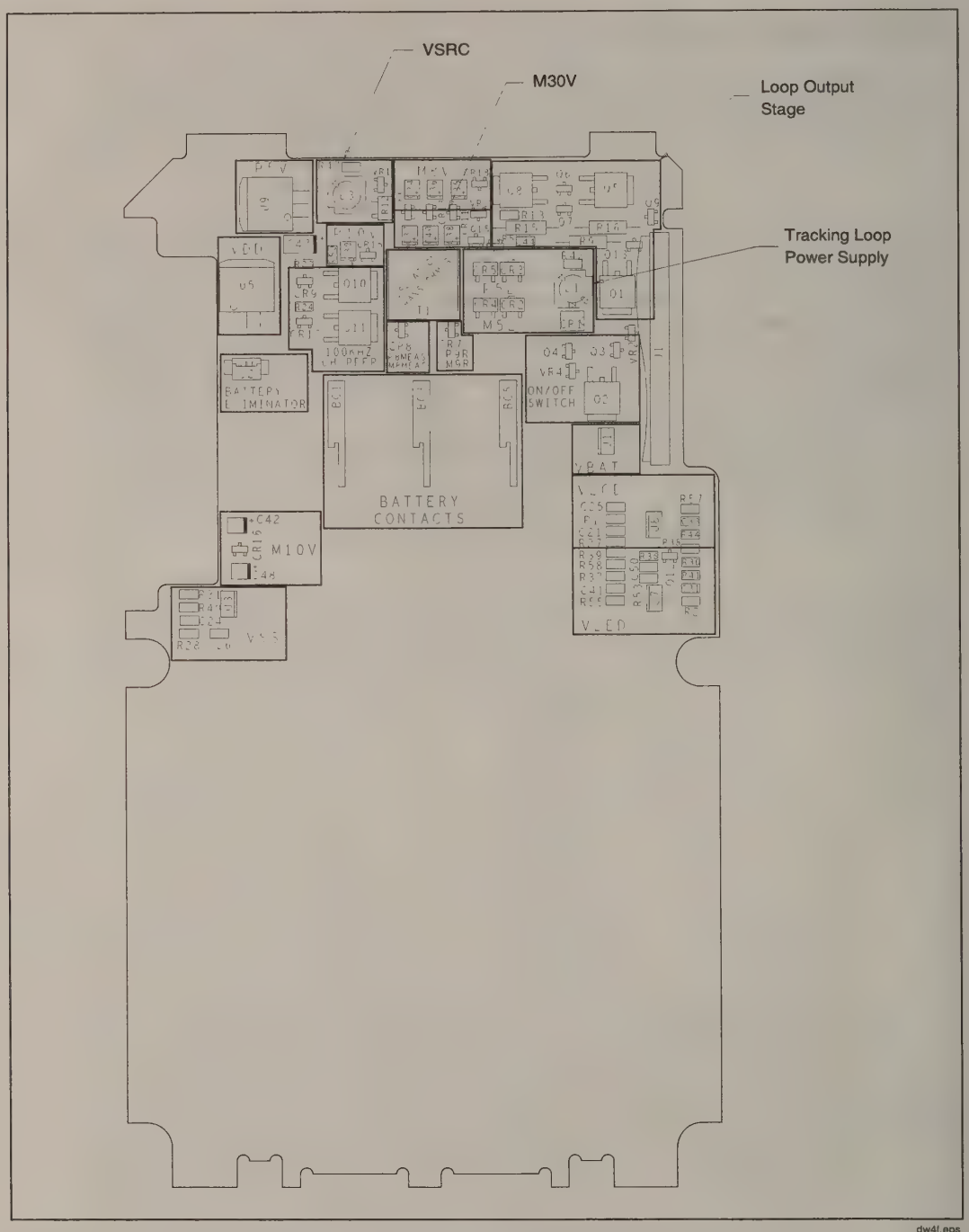

Figure 2-2. Power Supply Printed Circuit Assembly

Table 2-1. Power Supply Information

Voltage Name	Value	Function
P8MEAS	+8 V (unregulated)	Volts Measure
MD COM	Supply ground (unregulated)	Volts Measure
M8MEAS	-8 V (unregulated)	Volts Measure
P5L	+5 V (unregulated)	mA
LD COM	Supply ground (unregulated)	mA
M5L	-5 V (unregulated)	mA
P9R	+9 V (unregulated)	RS-232/Pressure
RS COM	Supply ground (unregulated)	RS-232/Pressure
M9R	-9 V (unregulated)	RS-232/Pressure
VDD	+5V (regulated)	V Source
P5V	+5V (regulated)	V Source (Digital Circuit)
VSS	-5V (regulated)	V Source
VSRC	Variable (+5 to +20V)	V Source
M30V	-30V (unregulated)	LCD Bias voltage
VLCD	Variable (0 to -28V)	LCD Contrast
VLED	Current Drain	Backlight Supply
M10V	-10V (unregulated)	Source (Output Stage)
P10V	+10V (unregulated)	Source Reference
M8V	-8V (unregulated)	-5V Supply
M30v	-30V (unregulated)	LCD Contrast

Digital Processing

The heart of the calibrator is a 132-pin Motorola MC68306 microprocessor, with on-board Programmable Logic Devices and dual UARTs. Crystal Y3 clocks the microprocessor at 10 MHz. Crystal Y2 clocks the dual UARTs at 3.6864 MHz. The microprocessor is complemented with nonvolatile memory (RAM devices U101 and U102), which use a 3V lithium battery (BT1) to hold their contents when the power is off.

Much of the digital control for the analog circuitry is through the serial-to-parallel latch (U119) and a multiple DAC device (U121). The DAC's outputs are referenced to a ±2.5V supply consisting of regulator U118 and amp U117.

Power-up sequence and resets are controlled by U114, which also serves as a "watchdog timer" if digital activity ceases. A real time clock (U106) controls interrupts, date, and time.

Firmware is stored in Flash ROM (U103) and calibration constants are stored in an EEPROM (U105).

To operate the display assembly, U107 is used for control logic while RAM U108 holds the video data.

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Maintenance

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Introduction

Fluke recommends recertification every year. To recertify, perform the verification procedure. If any test points are out of tolerance, you need to calibrate, then reverify. Two-year specifications are included for those customers who do not require the highest accuracy.

Performance Verification Test

The following tests verify compliance with Model 701 or 702 one or two year specifications.

Equipment Required for Verification

The primary source instrument used in the verification procedures is the Fluke 5500A. If a 5500A is not available, you can substitute another calibrator as long as it meets the minimum test requirements. If a 5500A is not available, use the alternate procedure for thermocouple source and measure verification.

- Fluke 5500A Calibrator.
- Hewlett Packard 3458A DMM (required for current and resistance measurement accuracy).
- If a 5500A is not available: PM6666 Frequency Counter.
- Oscilloscope, such as the Fluke ScopeMeter Model 93.
- Two short jumpers (banana type, PN 944632).
- Two sets of test leads.
- If a 5500A is available: Two polarized Type-K TC miniplugs with type-K thermocouple wire.
- If a 5500A is not available: Lag bath characterized by a standard thermometer and Type-K thermocouple. Examples are Princo ASTM-56C (Mercury Thermometer, 0.02°C Resolution), and a Dewar Flask and Cap (1-pint Thermos Bottle).

How to Verify

Verification procedures for each source and measure function follow. For each procedure there is a table of test points and acceptable readings. If the result of the test is outside the range shown, the 701 or 702 is out of tolerance and should be recalibrated or repaired if necessary. There are separate columns for each model and for one or two-year specifications wherever the specifications differ.

Follow these general instructions for all the tests:

- For all tests, run the 701 or 702 on battery power. Make sure the battery is fully charged. Do not use the battery eliminator.
- For measurement functions, press the [RANGE] button to lock the range on the range specified in the table of test points. You may need to press [RANGE] several times. Range names in the specification tables include the 10% overrange capability. Range names on the 701 or 702 display do not include the 10% overrange. For example, the UUT display shows **Range 100 mV,** but the range name in the table is 110 mV.
- Allow each item of verification equipment to satisfy its specified warmup period.
- Allow the 701 or 702 a minimum of 5 minutes to warm up.

- For each test, make sure the verification equipment has settled.
- For each test point that uses the 5500A, wait for the 5500A output to settle, and wait for the ~ (unsettled) annunciator on the UUT to go out.

DC Volts Measurement

Proceed as follows to verify the dc volts measurement function:

1. Connect the UUT to the 5500A as shown in Figure 3-1. Connect the three lows (black input jacks) with jumpers.
2. Set the UUT to the dc volts measurement function.
3. Press [RANGE] on the UUT to lock on the 110 mV range.
4. Set the 5500A to the first test point in Table 3-1.
5. Observe the reading on the UUT and check to see if it is within the range shown under the appropriate column.
6. Continue through the test points, being careful to lock the UUT on the specified range.
7. When you are finished, set the 5500A to Standby.

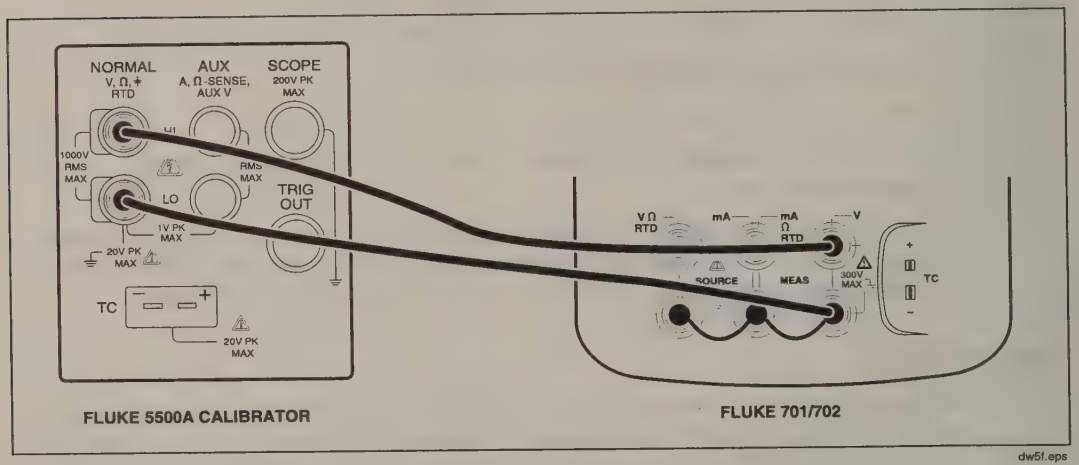

Figure 3-1. DC Volts and AC Volts Measure Connections

Table 3-1. DC Volts Measurement Verification Points

Range	Input	Model 702 1 Year	Model 702 2 Year	Model 701 1 Year	Model 701 2 Year
110 mV	0 mV	±0.016	±0.016	±0.016	±0.016
110 mV	100 mV	99.959 to 100.041	99.934 to 100.066	99.934 to 100.066	99.883 to 100.117
110 mV	-100 mV	-99.959 to -100.041	-99.934 to -100.066	-99.934 to -100.066	-99.883 to -100.117
1.1V	0 mV	±0.00006	±0.00006	±0.00006	±0.00006
1.1V	1.0V	0.99970 to 1.00031	0.99945 to 1.00056	0.99945 to 1.00056	0.9894 to 1.00106
1.1V	-1.0V	-0.99970 to -1.00031	-0.99945 to -1.00056	-0.99945 to -1.00056	-0.9894 to -1.00106
11V	0 mV	±0.0006	±0.0006	±0.0006	±0.0006
11V	10.0V	9.9970 to 10.0031	9.9945 to 10.0056	9.9945 to 10.0056	9.9895 to 10.0106
11V	-10.0V	-9.9970 to -10.0031	-9.9945 to -10.0056	-9.9945 to -10.0056	-9.9895 to -10.0106
110V	0 mV	±0.006	±0.006	±0.006	±0.006
110V	100.0V	99.945 to 100.056	99.895 to 100.106	99.945 to 100.056	99.895 to 100.106
110V	-100.0V	-99.945 to -100.056	-99.895 to -100.106	-99.945 to -100.056	-99.895 to -100.106
300V	0 mV	±0.02	±0.02	±0.02	±0.02
300V	300.0V	299.83 to 300.16	299.69 to 300.32	299.83 to 300.16	299.69 to 300.32
300V	-300.0V	-299.83 to -300.16	-299.69 to -300.32	-299.83 to -300.16	-299.69 to -300.32

AC Volts Measurement

Proceed as follows to verify the ac volts measurement function:

1. Connect the UUT to the 5500A as shown in Figure 3-1. Connect the three lows (black jacks) with jumpers.
2. Set the UUT to the ac volts measurement function.
3. Press RANGE on the UUT to lock on the 1.1V range.
4. Set the 5500A to the first test point in Table 3-2. Wait for the output to settle.
5. Observe the reading on the UUT and check to see if it is within the range shown.
6. Continue through the test points, being careful to lock the UUT on the specified range.
7. When you are finished, set the 5500A to Standby.

Table 3-2. AC Volts Measurement Verification Points

Range	RMS V	Frequency	Models 701 and 702 1 and 2 Year
1.1V	200 mV	500 Hz	0.1985 to 0.2015
1.1V	1.0V	20 Hz	0.9790 to 1.0210
1.1V	1.0V	40 Hz	0.9945 to 1.0055
1.1V	1.0V	500 Hz	0.9945 to 1.0055
1.1V	1.0V	1 kHz	0.9790 to 1.0210
1.1V	1.0V	5 kHz	0.8980 to 1.1020
11V	2.0V	500 Hz	1.985 to 2.015
11V	10.0V	500 Hz	9.945 to 10.055
11V	10.0V	5 kHz	8.980 to 11.020
110V	20.0V	500 Hz	19.85 to 20.15
110V	100.0V	500 Hz	99.45 to 100.55
110V	100.0V	5 kHz	89.80 to 110.20
300V	50.0V	500 Hz	49.3 to 50.8
300V	120.0V	60 Hz	118.9 to 121.1
300V	250.0V	500 Hz	248.2 to 251.8
300V	219.0V	5 kHz	195.1 to 242.9

DC Current Measurement

Proceed as follows to verify the dc current measurement function:

1. Connect the UUT to the 5500A as shown in Figure 3-2. Disconnect the jumpers from the three lows if they are present.
2. Set the UUT to the dc current measurement function.
3. Press [RANGE] on the UUT to lock on the 30 mA range.
4. Set the 5500A to the first test point in Table 3-3.
5. Observe the reading on the UUT and check to see if it is within the range shown under the appropriate column.
6. Continue through the test points, being careful to lock the UUT on the specified range.
7. When you are finished, set the 5500A to Standby.

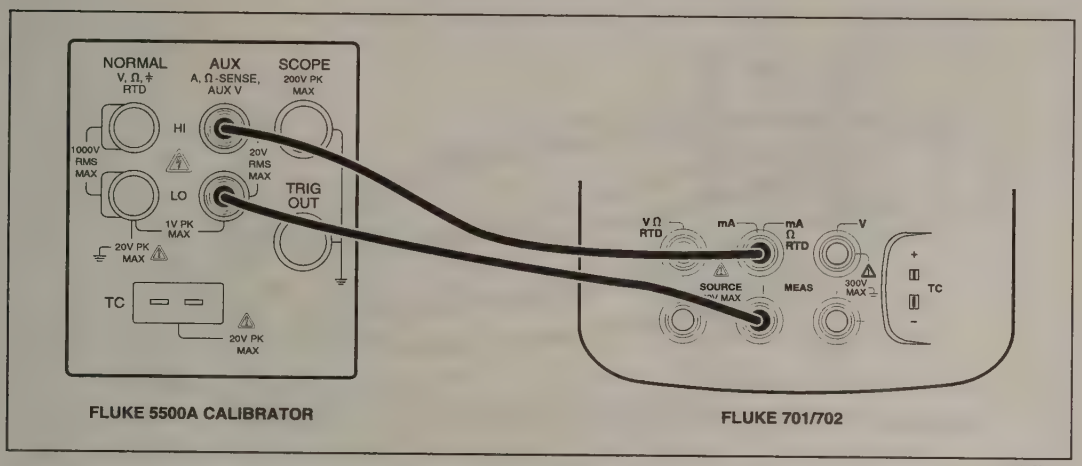

Figure 3-2. DC Current Measurement Verification Connections

Table 3-3. DC Current Measurement Verification Points

Range	Input	Model 702 1 Year	Model 702 2 Year	Model 701 1 Year	Model 701 2 Year
30 mA	4 mA	3.992 to 4.009	3.990 to 4.010	3.992 to 4.009	3.990 to 4.010
30 mA	20 mA	19.988 to 20.013	19.986 to 20.014	19.988 to 20.013	19.986 to 20.014
30 mA	30 mA	29.985 to 30.015	29.984 to 30.017	29.985 to 30.015	29.984 to 30.017
30 mA	-30 mA	-29.985 to -30.015	-29.984 to -30.017	-29.985 to -30.015	-29.984 to -30.017
110 mA	0 mA	±0.06	±0.07	±0.06	±0.07
110 mA	100 mA	99.90 to 100 .11	99.85 to 100.15	99.90 to 100.11	99.82 to 100.18
110 mA	-100 mA	-99.90 to -100 .11	-99.85 to -100.15	-99.90 to -100.11	-99.82 to -100.18

Resistance Measurement

Proceed as follows to verify the resistance measurement function:

1. Connect the UUT to the 5500A as shown in Figure 3-3. Use a two-wire connection transitioning to two wires at the UUT, and turn Four-Wire Compensation on. (If you are using a 5700A, use external sensing, and turn Two-Wire Compensation on.)
2. Set the UUT to the resistance measurement function.
3. Press [RANGE] on the UUT to lock on the 11Ω range.
4. Set the 5500A to the first test point in Table 3-4.
5. Observe the reading on the UUT and check to see if it is within the range shown under the appropriate column.
6. Continue through the test points, being careful to lock the UUT on the specified range.
7. When you are finished, set the 5500A to Standby.

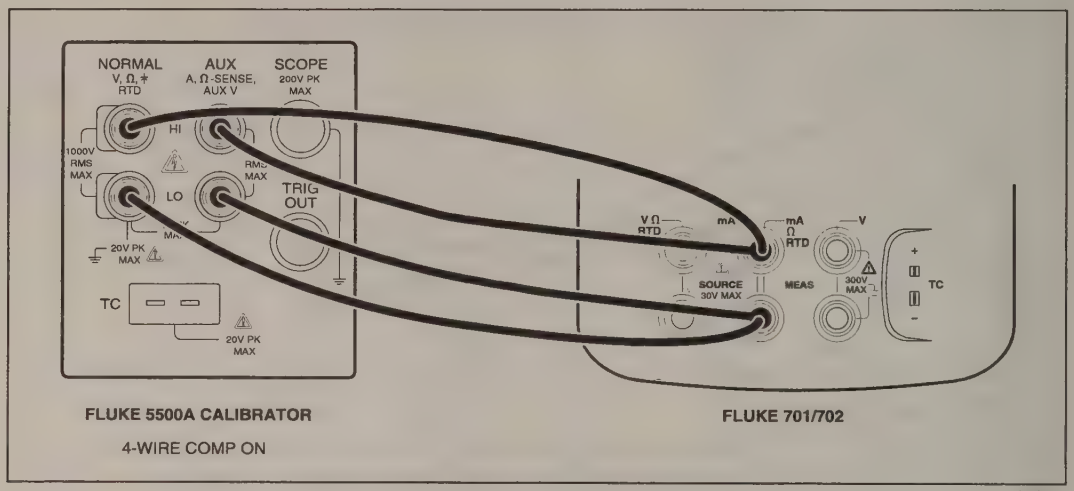

Figure 3-3. Resistance Measurement Verification Connections

Table 3-4. Resistance Measurement Verification Points

Range	Input	Model 702 1 Year	Model 702 2 Year	Model 701 1 Year	Model 701 2 Year
11Ω	0.0Ω	±0.050	±0.050	±0.050	±0.050
11Ω	10Ω	9.945 to 10.055	9.943 to 10.057	9.940 to 10.060	9.935 to 10.065
110Ω	0.0Ω	±0.05	±0.05	±0.05	±0.05
110Ω	100Ω	99.90 to 100.10	99.88 to 100.13	99.85 to 100.15	99.80 to 100.20
1100Ω	0.0Ω	±0.5	±0.5	±0.5	±0.5
1100Ω	1 kΩ	999.0 to 1001.0	998.8 to 1001.3	998.5 to 1001.5	998.0 to 1002.0
11 kΩ	0.0Ω	±0.010	±0.010	±0.010	±0.010
11 kΩ	10 kΩ	9.980 to 10.020	9.980 to 10.020	9.980 to 10.020	9.975 to 10.025

Frequency Measurement

Proceed as follows to verify the frequency measurement function:

1. Connect the UUT to the 5500A as shown in Figure 3-4. If you are using a calibrator other than a 5500A, connect a PM6666 Frequency Counter to the output through a dual banana plug to BNC adapter in order to adjust the frequency to the required accuracy. If you are using a 5700A Calibrator, you can connect the PM6666 to the Phase Out BNC connector on the 5700A rear panel.
2. Set the UUT to the frequency measurement function.
3. Select the <20 Hz range for the first step. Use the ≥20 Hz range thereafter.
4. Set the 5500A to the first test point in Table 3-5.
5. Observe the frequency reading on the UUT and check to see if it is within the range shown.
6. Continue through the test points.
7. When you are finished, set the 5500A to Standby.

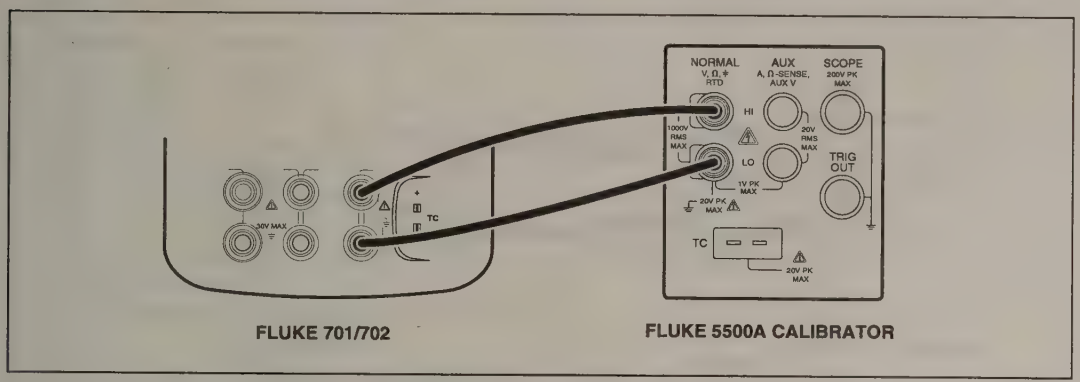

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Figure 3-4. Frequency Measurement Verification Connections

Table 3-5. Frequency Measurement Verification Points

Frequency Range	V RMS	Frequency	Models 701 and 702 1 and 2 Year
<20 Hz	110 mV	10 Hz	9.95 to 10.05
≥20 Hz	110 mV	500 Hz	499.5 to 500.5
≥20 Hz	700 mV	50 kHz	49.95 to 50.05

DC Volts Source

Proceed as follows to verify the dc volts source function:

1. Connect the UUT to the DMM as shown in Figure 3-5. You can use either the Fluke 8840A or HP3458A.
2. Set the UUT to the dc volts source function at -10 mV.
3. Observe the reading on the DMM and check to see if it is within the range shown under the appropriate column in Table 3-6.
4. Continue through the test points.
5. When you are finished, press [CLEAR (ZERO)] on the UUT twice to set the source function to off. This saves battery life.

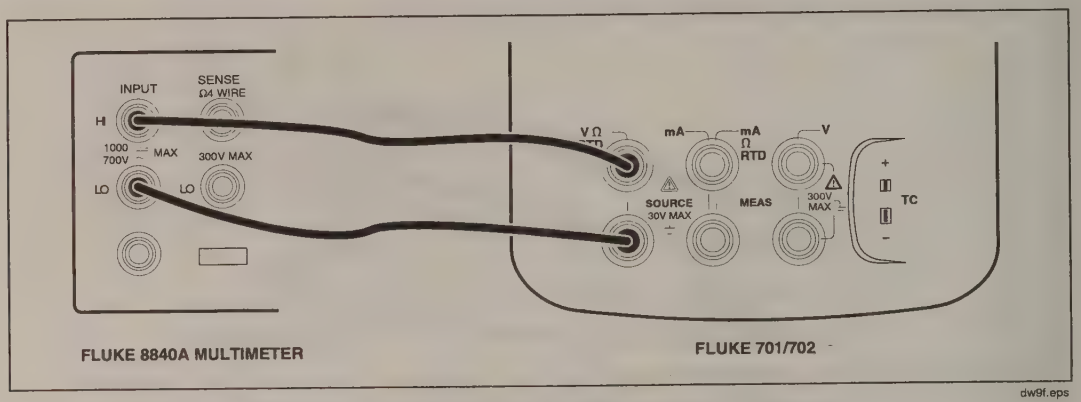

Figure 3-5. DC Volts Source Verification Connections

Table 3-6. DC Volts Source Verification Points

Range	Output	Model 702 1 Year	Model 702 2 Year	Model 701 1 Year	Model 701 2 Year
110 mV	-10 mV	-9.990 to -10.010	-9.987 to -10.013	-9.989 to -10.011	-9.985 to -10.015
110 mV	100 mV	99.972 to 100.028	99.969 to 100.031	99.962 to 100.038	99.949 to 100.051
1.1V	0.12V	0.11992 to 0.12008	0.11987 to 0.12013	0.11991 to 0.12009	0.11984 to 0.12016
1.1V	1.0V	0.99975 to 1.00025	0.99969 to 1.00031	0.99964 to 1.00036	0.99949 to 1.00051
11V	1.2V	1.1992 to 1.2008	1.1987 to 1.2013	1.1991 to 1.2009	1.1984 to 1.2016
11V	10.0V	9.9975 to 10.0026	9.9969 to 10.0031	9.9965 to 10.0036	9.9949 to 10.0051

DC Current Source

Proceed as follows to verify the dc current source function. The HP3458A is recommended because of its current measurement accuracy. You can substitute a Fluke 8505A and an accurate current shunt.

1. Connect the UUT to the HP 3458A DMM as shown in Figure 3-6.
2. Set the HP3458A [NPLC] to 30, and the function to dc current.
3. Set the UUT to the dc current source (not Simulate Transmitter) function at 2 mA.
4. Observe the reading on the DMM and check to see if it is within the range shown under the appropriate column in Table 3-7.
5. Continue through the test points.
6. When you are finished, press [CLEAR (ZERO)] twice on the UUT to set the source function to off. This saves battery life.

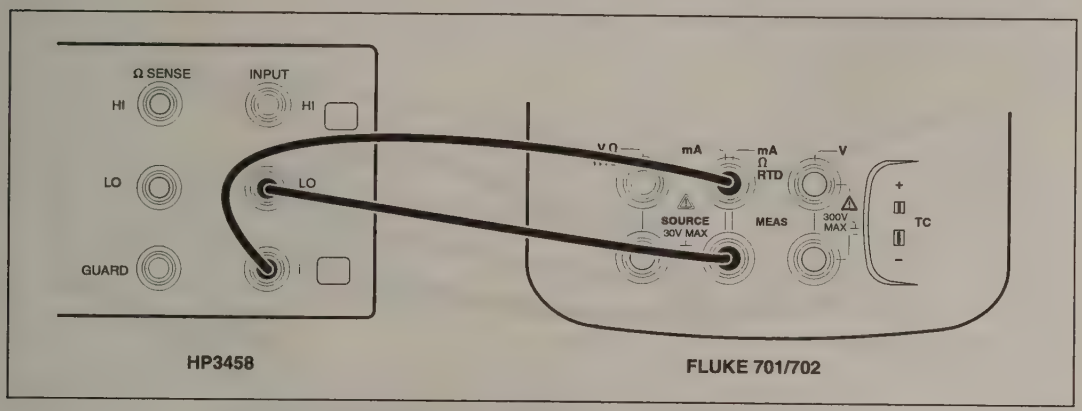

Figure 3-6. DC Current Source Verification Connections

Table 3-7. DC Current Source Verification Points

Output	Models 701 and 702 1 Year	Models 701 and 702 2 Year
2 mA	1.991 to 2.009	1.986 to 2.014
4 mA	3.991 to 4.009	3.986 to 4.014
22 mA	21.989 to 22.011	21.982 to 22.018

Simulate Transmitter Function

Note

Simulate transmitter function specifications are as follows: both models, 1 and 2 year: 0.25% of reading + 0.05% of full scale up to a maximum output of 22 mA.

Proceed as follows to verify the simulate transmitter function (accessed through dc current source):

1. Connect the UUT, HP3458A, and 5500A as shown in Figure 3-7. The 5500A is used as a stable dc voltage source. Its value is not critical, and another dc source such as a battery can be substituted.
2. Set the HP3458A [NPLC] to 30, and the function to dc current.
3. Set the UUT to the source mA function, then select **Simulate Transmitter**.
4. Set the UUT source value to 4 mA.
5. Set the 5500A to output 4V dc.
6. Observe the current reading on the DMM and check to see if it is within the range shown in Table 3-8.
7. Set the UUT source value to 22 mA and check the results again in Table 3-8.
8. Set the 5500A to Standby, and press [CLEAR (ZERO)] twice on the UUT to turn sourcing off.

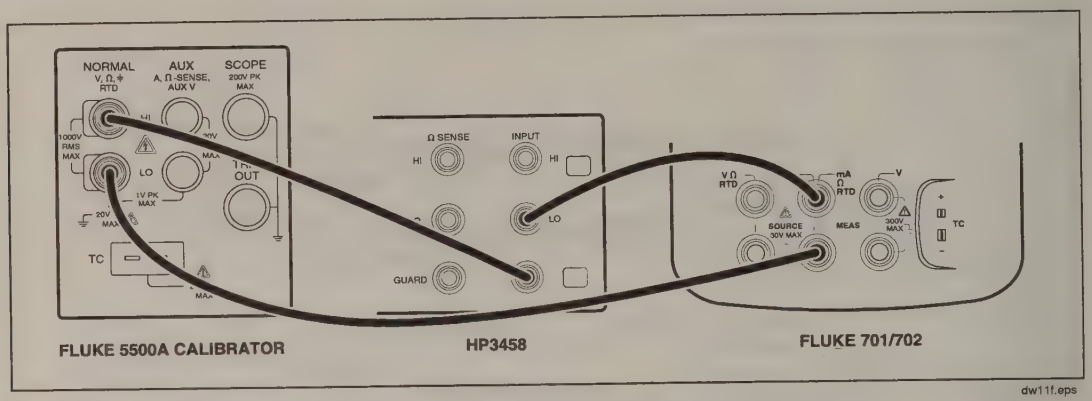

Figure 3-7. Simulate Transmitter Verification Connections

Table 3-8. Simulate Transmitter Verification Points

Range	Output	Models 701 and 702 1 and 2 Year
22 mA	4 mA	3.979 to 4.021
22 mA	22 mA	21.934 to 22.066

Resistance Source

Proceed as follows to verify the resistance source function.

1. Connect the UUT to the HP 3458A DMM as shown in Figure 3-8. Use a four-wire connection transitioning to two wires at the UUT.
2. Select four-wire measurement on the DMM.
3. Set the UUT to the resistance source function at 0.1Ω.
4. Observe the reading on the DMM and check to see if it is within the range shown under the appropriate column in Table 3-9.
5. Continue through the test points.
6. When you are finished, press [CLEAR (ZERO)] twice on the UUT to set the source function to off. This saves battery life.

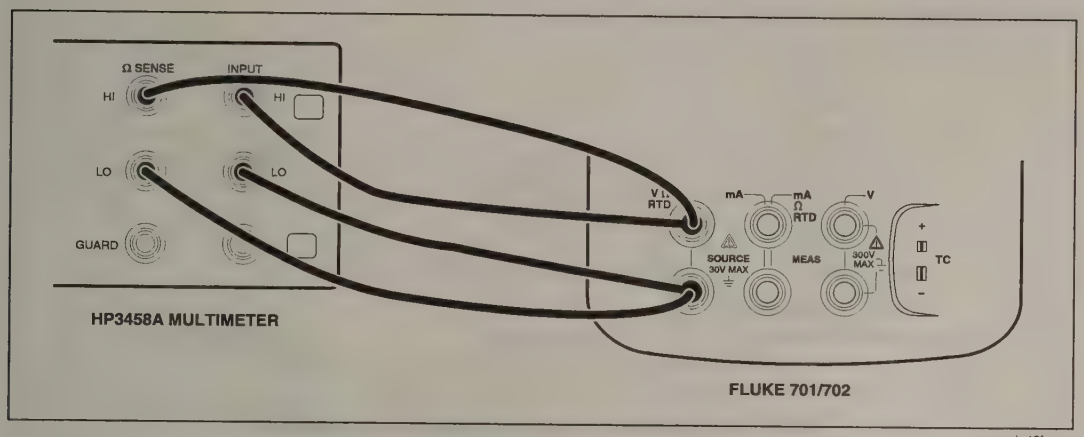

Figure 3-8. Resistance Source Verification Connections

Table 3-9. Resistance Source Verification Points

Range	Output	Model 702 1 Year	Model 702 2 Year	Model 701 1 Year	Model 701 2 Year
11Ω	0.1Ω	0.050 to 0.150	0.050 to 0.150	0.050 to 0.150	0.000 to 0.200
11Ω	1Ω	0.950 to 1.050	0.950 to 1.051	0.950 to 1.051	0.900 to 1.100
11Ω	10Ω	9.948 to 10.052	9.945 to 10.055	9.945 to 10.055	9.899 to 10.101
110Ω	20Ω	19.95 to 20.05	19.94 to 20.06	19.94 to 20.06	19.89 to 20.11
110Ω	100Ω	99.93 to 100.07	99.90 to 100.10	99.90 to 100.10	99.85 to 100.15
1.1 kΩ	200Ω	0.1994 to 0.2006	0.1994 to 0.2007	0.1993 to 0.2007	0.1992 to 0.2008
1.1 kΩ	1 kΩ	0.9990 to 1.0010	0.9988 to 1.0013	0.9985 to 1.0015	0.9980 to 1.0020
11 kΩ	2 kΩ	1.993 to 2.007	1.992 to 2.008	1.992 to 2.008	1.990 to 2.010
11 kΩ	10 kΩ	9.985 to 10.015	9.980 to 10.020	9.980 to 10.020	9.970 to 10.030

Frequency Source

Proceed as follows to verify the frequency source function:

1. Connect the UUT to the frequency counter as shown in Figure 3-9.
2. Set the UUT to the frequency source function at 1.0V, 5 Hz.
3. Observe the reading on the frequency counter and check to see if it is within the range shown in Table 3-10.
4. Disconnect the frequency counter and use the ScopeMeter to check for a typical 50% duty cycle square wave with 1.0V pk amplitude. The amplitude must be within the tolerance shown in Table 3-10.
5. Continue through the test points.
6. When you are finished, press [CLEAR (ZERO)] twice on the UUT to set the source function to off. This saves battery life.

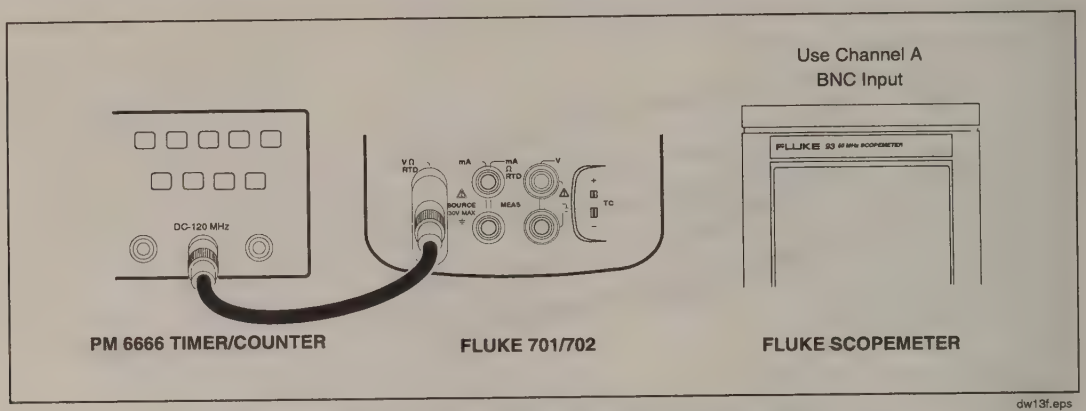

Figure 3-9. Frequency Source Verification Connections

Table 3-10. Frequency Source Verification Points

V Pk	Frequency	Frequency, Models 701 and 702 1 and 2 Year	Amplitude Tolerance
1.0V	5 Hz	4.99 to 5.01	±80 mV pk
1.0V	500 Hz	499 to 501	±80 mV pk
1.0V	50 kHz	48 to 52	±350 mV pk

Thermocouple Measure

Proceed as follows to verify the thermocouple measure function. This test uses a Type-K thermocouple setting on the UUT. If you do not have access to a Fluke 5500A Calibrator, use the alternate procedure that follows this primary procedure.

1. Use Type-K thermocouple wire and Type-K miniplugs to connect the UUT TC jack to the 5500A TC jack as shown in Figure 3-10, observing correct polarity.
2. Set the UUT to the thermocouple measure function, TC Type K; in the SETUP menu, select ITS-90 scale, internal reference, and °C.
3. Set the 5500A to source -180°C, Type-K, ITS-90 scale. Enable the internal reference on the 5500A.
4. Wait 1 minute for thermal emfs caused by inserting the connectors to dissipate.
5. Observe the reading on the UUT and check to see if it is within the range shown under the appropriate column in Table 3-11.
6. Continue through the test points.
7. When you are finished, set the 5500A to Standby.

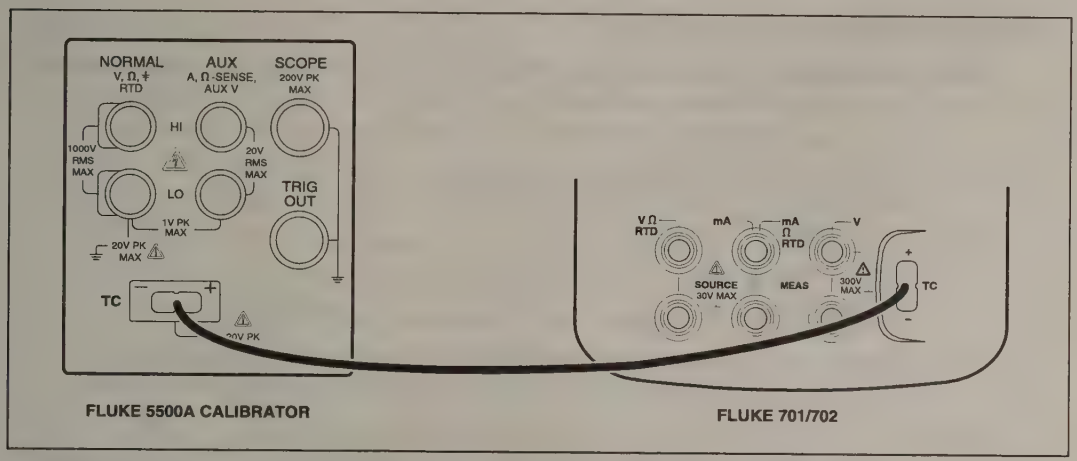

Figure 3-10. Temperature Measure (TC) Verification Connections

Table 3-11. Temperature Measure Verification (Type-K Thermocouple, ITS-90)

°C (mV Equivalent Referenced to 0°C)	Models 701 and 702 1 Year Reading, °C	Models 701 and 702 2 Year Reading, °C
-180 °C (-5.550 mV)	-179.0 to -181.0	-178.8 to -181.2
0 °C (0.000 mV)	±0.5	±0.8
1300 °C (52.410 mV)	1299.1 to 1300.9	1298.6 to 1301.4

Thermocouple Measure, Alternate

Use this alternate procedure if a Fluke 5500A Calibrator is not available. The alternate procedure uses the following equipment:

- Fluke 5700A Calibrator.
- Standard Thermometer with 0.1% accuracy.
- Room temperature lag bath.
- Type-K/copper thermocouple test cable.
- Voltage/temperature chart for Type-K thermocouple, ITS-90.

1. Prepare a room-temperature lag bath using a thermos bottle, and insert the thermometer and thermocouple wire into the bath. Allow the lag bath at least 15 minutes to stabilize.
2. Use Type-K thermocouple wire and copper wire to connect the 5700A output to the UUT TC jack as Figure 3-11 shows. The junctions should be either welded or made with tight screw terminals and submersed in the lag bath (room temperature).
3. Use the standard thermometer to measure the temperature of the lag bath.
4. Use the 5700A to source the millivolt equivalents of the temperatures in Table 3-11. At each point, correct the 5700A output voltage by subtracting the millivolt equivalent of the Type-K junction at the lag bath temperature. (Use the Type-K ITS-90 chart.)
5. Observe the reading on the UUT and check to see if it is within the range shown under the appropriate column in Table 3-11.
6. When you are finished, set the 5700A to Standby.

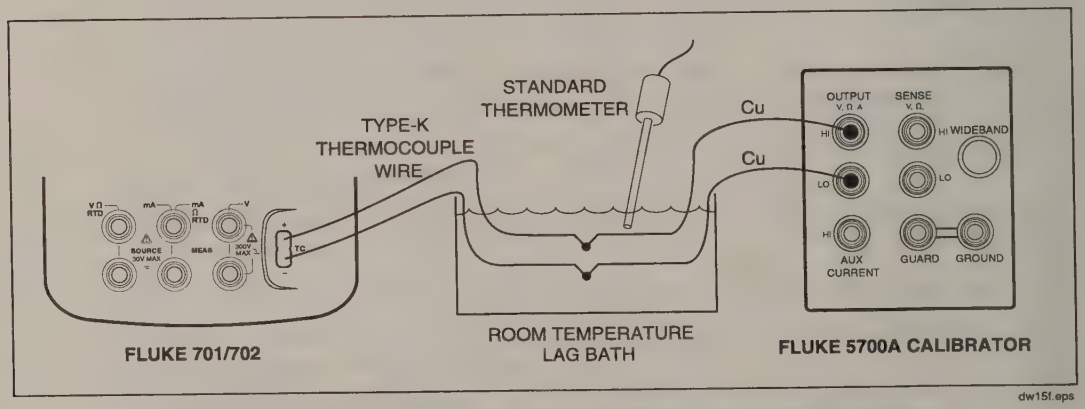

Figure 3-11. Temperature Measure (TC) Verification Connections (Alternate)

Thermocouple Source

Proceed as follows to verify the thermocouple source function. This test uses a Type-K thermocouple setting on the UUT. If you do not have access to a Fluke 5500A Calibrator, use the alternate procedure that follows this primary procedure.

1. Use Type-K thermocouple wire and Type-K miniplugs to connect the UUT TC jack to the 5500A TC jack as shown in Figure 3-10, observing correct polarity.
2. Set the UUT to the thermocouple source function, TC Type K; in the SETUP menu, select ITS-90 scale, internal reference, and °C.
3. Set the UUT to source -200°C.
4. Set the 5500A to measure a thermocouple, Type-K, ITS-90 scale. Enable the internal reference on the 5500A.
5. Wait 1 minute for thermal emfs caused by inserting the connectors to dissipate.
6. Observe the reading on the 5500A and check to see if it is within the range shown under the appropriate column in Table 3-12.
7. Continue through the test points.
8. When you are finished, press CLEAR (ZERO) twice on the UUT to set the source function to off. This saves battery life.

Table 3-12. Temperature Source Verification (Type-K Thermocouple, ITS-90)

Output °C (Or V) (Referenced to 0°C)	Models 701 and 702 1 Year 5500A Reading, °C	Models 701 and 702 2 Year 5500A Reading, °C
-200 °C (-5.891 mV)	-199.0 to 201.0	-189.8 to -201.2
0 °C (0.000 mV)	±0.5	±0.8
1370 °C (54.819 mV)	1369.1 to 1370.9	1369.6 to 1371.4

Thermocouple Source, Alternate

Use this alternate procedure if a Fluke 5500A Calibrator is not available. The alternate procedure uses the following equipment:

- Fluke 8840A DMM.
- Standard Thermometer with 0.1% accuracy.
- Room temperature lag bath.
- Type-K/copper thermocouple test cable.
- Voltage/temperature chart for Type-K thermocouple, ITS-90.

1. Prepare a room-temperature lag bath using a thermos bottle, and insert the thermometer and thermocouple wire into the bath. Allow the lag bath at least 15 minutes to stabilize.
2. Use Type-K thermocouple wire and copper wire to connect the 8840A input to the UUT TC jack as Figure 3-11 shows. (The 8840A is used instead of the 5700A.) The junctions should be either welded or made with tight screw terminals and submersed in the lag bath (room temperature).

3. Use a the standard thermometer to measure the temperature of the lag bath.
4. Source each of the temperatures in Table 3-12 from the UUT. At each point, correct the DMM measured voltage by algebraically adding the millivolt equivalent of the Type-K junction at the lag bath temperature (use the Type-K ITS-90 chart).
5. Use the Type-K ITS-90 chart to convert the corrected reading on the DMM to temperature and compare the result with the values under the appropriate column in Table 3-12.
6. When you are finished, press CLEAR (ZERO) twice on the UUT to set the source function to off. This saves battery life.

RTD Measure, Four-Wire

Proceed as follows to verify the four-wire RTD measure function. Because the two and three-wire RTD measure functions use different circuits, they require separate verification procedures. If a 5500A is not available, substitute a variable resistance source such as a General Resistance RTD-100 RTD Simulator and use the resistance equivalents shown in Table 3-13. Use the 8840A DMM to measure the variable resistance source and adjust it accurately.

1. Connect the UUT to the 5500A as shown in Figure 3-12. Use a four-wire connection and 4-wire compensation.
2. Set the UUT to the RTD measure function, Pt100 (385), and four-wire termination.
3. Set the 5500A to RTD, Pt100 (385) at -200°C, and comp four-wire. Set the 5500A to Operate.
4. Observe the reading on the UUT and check to see if it is within the range shown under the appropriate column in Table 3-13.
5. Continue through the test points.
6. When you are finished, set the 5500A to Standby.

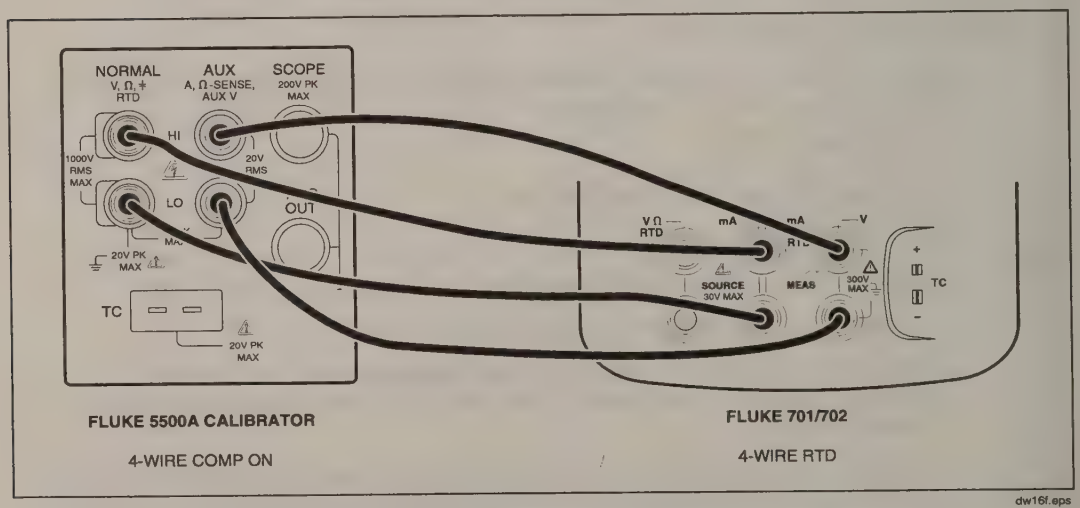

Figure 3-12. Four-Wire RTD Measure Verification Connections

Table 3-13. RTD Measure Verification (100Ω Pt(385), Four-Wire Connection)

Input °C (Resistance)	Model 701 and 702 1 Year Reading, °C	Model 701 and 702 2 Year Reading, °C
-200° (19.42Ω)	-199.7 to -200.3	-199.5 to -200.5
0° (100Ω)	±0.3	±0.5
300° (212.05Ω)	299.5 to 300.5	299.2 to 300.8

RTD Measure, Three-Wire

Proceed as follows to verify the three-wire RTD measure function. Because the two and four-wire RTD measure functions use different circuits, they have separate verification procedures. If a 5500A is not available, substitute a variable resistance source such as a General Resistance RTD-100 RTD Simulator and use the resistance equivalents shown in Table 3-14. Use the 8840A DMM to measure the variable resistance source and adjust it accurately.

1. Connect the UUT to the 5500A as shown in Figure 3-13.
2. Set the UUT to the RTD measure function, Pt100 (385), 3 Wire.
3. Set the 5500A to source an RTD, Pt100 (385) at -200°C.
4. Observe the reading on the UUT and check to see if it is within the range shown under the appropriate column in Table 3-14.
5. Continue through the test points.
6. When you are finished, set the 5500A to Standby.

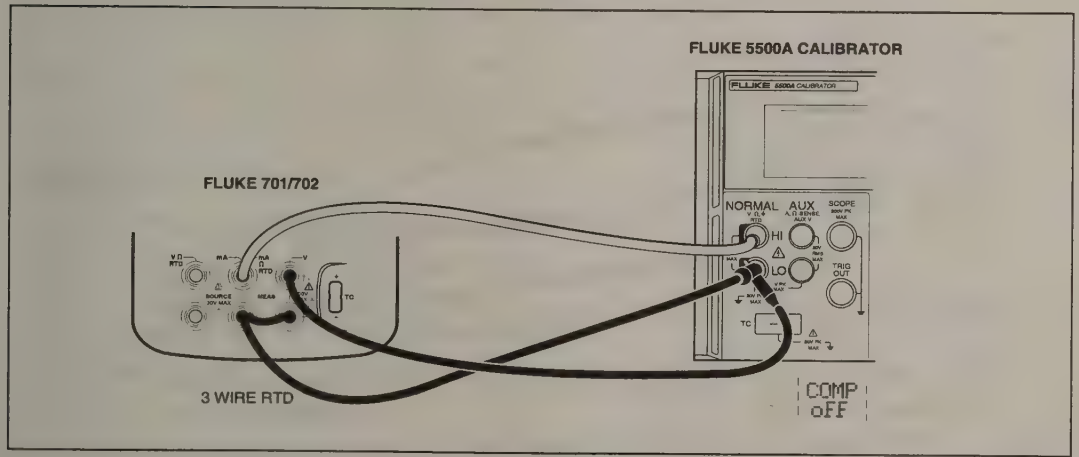

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Figure 3-13. Three-Wire RTD Measure Verification Connections

Table 3-14. RTD Measure Verification (100Ω Pt(385), Three-Wire Connection)

Input °C (Resistance)	Model 702 1 Year Reading, °C	Model 701 2 Year Reading, °C
-200° (18.49Ω)	-199.3 to -200.7	-199.1 to -200.9
0° (100Ω)	±0.9	±1.2
300° (212.02Ω)	298.8 to 301.2	298.6 to 301.4

RTD Measure, Two-Wire

Proceed as follows to verify the two-wire RTD measure function. Because the three and four-wire RTD measure functions use different circuits, they have separate verification procedures. If a 5500A is not available, substitute a variable resistance source such as a General Resistance RTD-100 RTD Simulator and use the resistance equivalents shown in Table 3-13. Use the 8840A DMM to measure the variable resistance source and adjust it accurately.

1. Connect the UUT to the 5500A as shown in Figure 3-14.
2. Set the UUT to the RTD measure function, Pt100 (385), two-wire.
3. Set the 5500A to source an RTD, Pt100 (385) at -200°C.
4. Observe the reading on the UUT and check to see if it is within the range shown under the appropriate column in Table 3-15.
5. Continue through the test points.
6. When you are finished, set the 5500A to Standby.

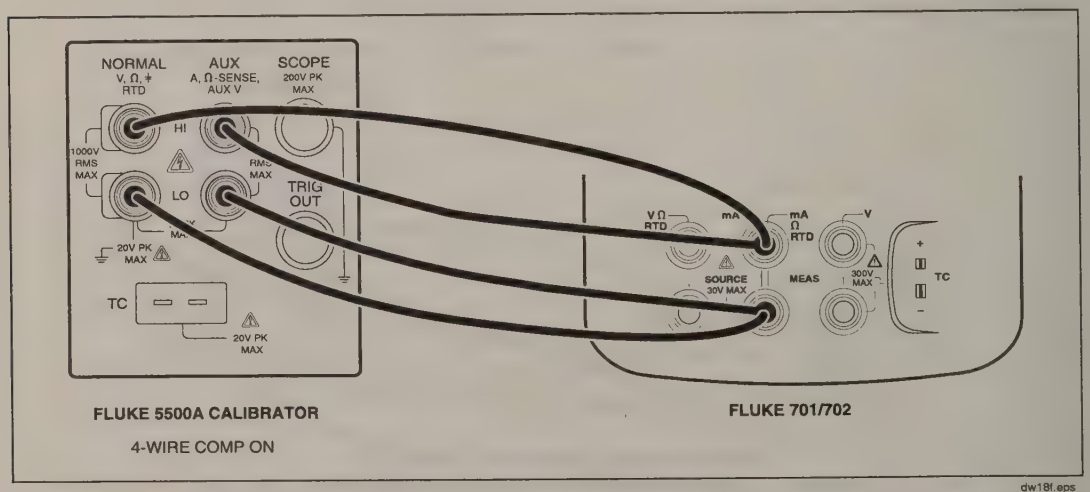

Figure 3-14. Two-Wire RTD Measure Verification Connections

Table 3-15. RTD Measure Verification (100Ω Pt(385), Two-Wire Connection)

Input °C (Resistance)	Model 702 1 Year Reading, °C	Model 701 2 Year Reading, °C
-200° (18.49Ω)	-199.3 to -200.7	-199.1 to -200.9
0° (100Ω)	±0.9	±1.2
300° (212.02Ω)	298.8 to 301.2	298.6 to 301.4

RTD Source

Proceed as follows to verify the RTD source function:

1. Connect the UUT to the 8840A DMM as shown in Figure 3-8. Use a 4-wire connection transitioning to 2 wires at the UUT. Select kΩ-4 wire on the 8840A.
2. Set the UUT to the RTD source function, Pt100 (385) at -180°C.
3. Observe the resistance reading on the DMM and check to see if it is within the range shown under the appropriate column in Table 3-16.
4. Continue through the test points.
5. When you are finished, press [CLEAR (ZERO)] twice on the UUT to set the source function to off. This saves battery life.

Table 3-16. RTD Source Verification (100Ω Pt(385))

Output	Model 701 and 702 1 Year Ω	Model 701 and 702 2 Year Ω
-180 °C	26.9 to 27.2	26.8 to 27.3
100 °C	138.3 to 138.6	138.2 to 138.8
310 °C	215.3 to 215.8	215.2 to 215.9

Loop Power

Proceed as follows to verify the Loop Power function.

1. Connect the UUT to the 8840A DMM as shown in Figure 3-15.
2. On the UUT press [SETUP], [ENTER], select **Loop Power 24V**, and press [ENTER] again.
3. Observe the no-load voltage reading on the DMM and verify that it is within the range shown in Table 3-17.
4. Set the Loop Power voltage to the 28V setting and repeat step 3.
5. When complete, disable Loop Power through the [SETUP] menu or by turning the UUT off.

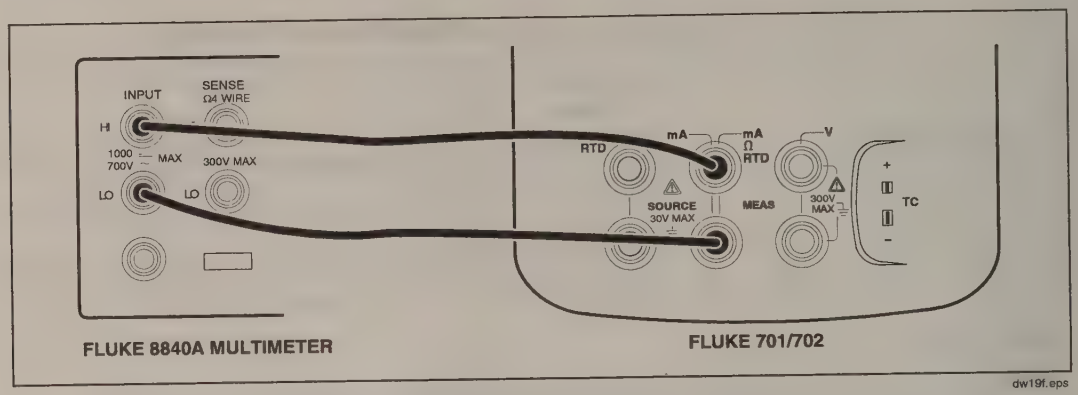

Figure 3-15. Loop Power Verification Connections

Table 3-17. Loop Power Verification

Setting	Models 701 and 702 1 and 2 Year
24 Volt	22.8 to 25.2
28 Volt	26.6 to 29.4

Calibration

Calibration is required only if a calibrator fails verification. Always reverify after calibration.

Both the 701 and 702 Documenting Process Calibrators have the same calibration procedure. The instructions are minimal for calibration because of the built-in guided procedure in the 701 and 702. A software routine in the 701 or 702 produces displays that give you step-by-step prompts for the correct stimulus or measurement. The guided procedures show which jacks to use to apply the stimulus or take the measurement and which jacks need to be shorted with jumpers. Follow the instructions exactly to complete each calibration routine successfully.

Calibration is all done in software. There are no physical adjustments. At the end of each of the 10 calibration subroutines you are prompted to either save the new constants, or abandon them and start over.

There are 10 subroutines in the Calibration display. You access this display by pressing SETUP, and then the **Next Page** softkey three times. The subroutines are as follows:

- **Volts DC Measure**
- **Volts AC Measure**
- **Frequency Measure**
- **mA Measure**
- **Volts DC Source**
- **Frequency Source**
- **Ohms Source**
- **mA Source**
- **Ohms Measure**
- **TC Measure**

At the top of the display is the **Calibration Status** followed by a number. This number is incremented after each subroutine is finished and the new constants are saved. Doing a complete calibration increments the **Calibration Status** by 10. Because the Calibration Status number can be changed only by recalibrating, you can use it to confirm that a previous calibration is intact.

Order in Which to Calibrate

To completely calibrate a 701 or 702, do each of the 10 subroutines. The best course is to do them in order from top to bottom. However, the first seven are independent and can be done in any order. The last three subroutines (**mA Source, Ohms Measure,** and **TC Measure**) must be done in a specific order, as follows:

1. If **mA Source** is to be calibrated, **mA Measure** must be calibrated first.
2. If **Ohms Measure** is to be calibrated, the following subroutines must be done first in the order shown: **Volts DC Measure**, **mA Measure**, **mA Source**, and **Ohms Measure**.
3. If **TC Measure** is to be calibrated, **Volts DC Source** must be calibrated first.

Equipment Required for Calibration

The required accuracy of the source or measurement does not correspond to the number of decimal places shown on the 701 or 702 display. For example, in Frequency Measure calibration when the display requests a source value of 5.00000V at 1.00000 kHz, the required accuracies are not of that magnitude. Simply use an accurate source and measurement equipment such as the Fluke 5500A or 5700A Calibrators, and a Fluke 8840A or better DMM. When dc current measurements are requested, an HP3458A is suggested, or you can use a precision current shunt with a Fluke 8505A DMM.

The following equipment is required to perform all 10 calibration subroutines:

- 5 1/2-digit or better DMM such as the Fluke 8840A.
- Fluke 5500A or 5700A Calibrator
- PM6666 Frequency Counter.
- A dual banana shorting bar.
- Two short jumpers with stackable banana plugs (Fluke PN 944632).
- If a 5500A is available: Two polarized Type-K TC miniplugs with Type-K thermocouple wire.
- If a 5500A is not available: Lag bath characterized by a standard thermometer and Type-K thermocouple. Examples are Princo ASTM-56C (Mercury Thermometer, 0.02°C Resolution), and a Dewar Flask and Cap (1-pint Thermos Bottle).

How to Calibrate

Do not use the ac adapter (BE9005). Make sure the battery has a full charge. Allow a minimum of 5 minutes warmup before you begin calibration. Proceed as follows to calibrate the 701 or 702:

1. Allow the specified warmup time for the source device.
2. Turn on the 701 or 702 and press SETUP and then the **Next Page** softkey three times.
3. The cursor bar is at **Volts DC Measure**. If you want to start with another subroutine, use the ▼ and ▲ keys to move the cursor to the desired subroutine. To start, press the **Calibrate** softkey.
4. For **Volts DC Measure**, do as the display illustrates: connect a shorting bar across the right side high and low jacks (not the TC connector), then connect all three lows together with two jumpers. Press the **Continue** softkey.

Caution

Do not force a dual banana plug between any two jacks in the horizontal orientation. (See Figure 3-16.) Doing so will damage the jacks. Use the supplied jumper wires. You can use a dual banana plug in the vertical orientation.

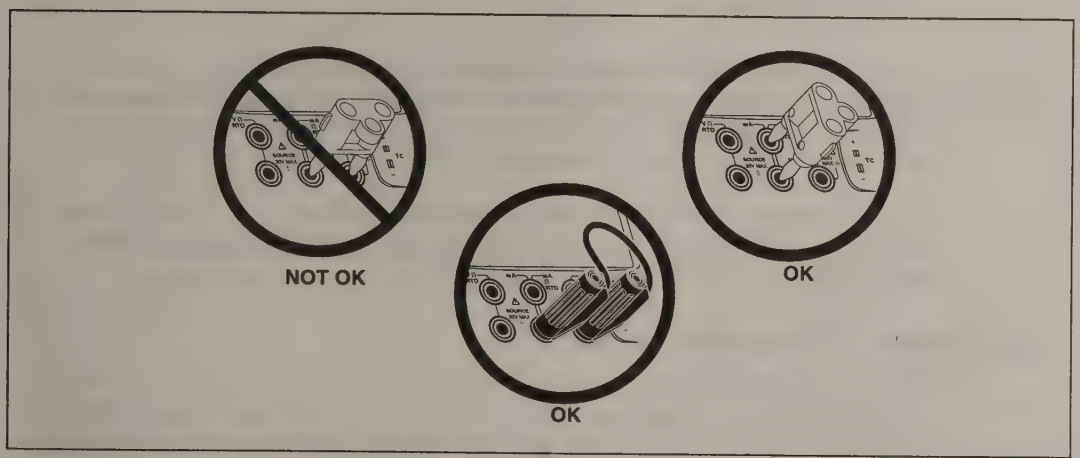

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Figure 3-16. Proper and Improper Jumper Use

5. Again, do as the display illustrates: remove the shorting bar, connect the test leads from the right side jacks to the output of the dc source. The display requests an input of **100.000 mV** dc but shows an allowed range of **90.0 ≤ 100.000 mV ≤ 110.0**.

   Apply the requested input at the resolution shown, or apply an input in the allowed range and use the numeric keys to enter the value into the 701 or 702, followed by ENTER. Press the **Continue** softkey.
6. Apply the next requested value as in step 5. Press the **Continue** softkey.

⚠ Warning

Some of the voltages required for calibration are dangerous. To avoid injury or death from electric shock, do not touch live conductors during high voltage calibration. Put the source device into Standby after each calibration step.

7. Continue applying voltages as requested. Make sure you follow the hookup instructions each time because the input jack configuration changes.
8. When you complete the last point in the subroutine, the display asks you if you want to save the new constants. If you save the new constants, the calibration takes effect and the **Calibration Status** counter is incremented and the date is updated. If you discard the constants at this point, the calibration has no effect, the **Calibration Status** counter is not incremented, and the date does not change. If one or more of the calibration stimuli (or measurements) were out of range, the message **Error - Calibration Constant Out of Bounds** appears, and you will need to restart the calibration subroutine.
9. The other functions are also calibrated by following step-by-step instructions on the display. When you calibrate the frequency source function, it requests that you measure the frequency and voltage output. This is a 50% duty cycle square wave, and the amplitude needs to be measured in pk volts, so multiply the DMM reading by 2. The DMM must be a true-rms type.

   When you calibrate the mA Measure function, the display requests 0.0 mA input. This does not equate to a short between mA high and low. Instead, set the source device to source 0.0 mA, which is in effect the same as an open circuit at the mA jacks.

   For TC Measure calibration, see the Thermocouple Measure part of the verification procedure for the correct techniques. You will need to use a lag bath if a 5500A is not available.

Adjustment of Potentiometers

There are three potentiometers on the Main PCA: R82, R83, and R77. Normally these never need adjustment. When the calibrator is manufactured, the factory adjusts these to tune out common mode error. If after repair you need to repeat this adjustment, proceed as follows. These adjustments are made with the 701 or 702 powered on. Use the "Access Procedures" to gain access to the Main PCA.

1. Set the calibrator to the dc voltage measure function.
2. Short the V MEAS high and low jacks together.
3. Apply 10V at 60 Hz between the V MEAS jacks (HI) and TP12 (LO).
4. Adjust R82 for a minimum output measured at TP24 (HI). (LO is still TP12.) This value must be less than 3 mV rms.
5. Remove the jumper.
6. Set the calibrator to the dc current measure function.
7. Apply 10V @ 60 Hz between mA Ω RTD MEAS low and TP12.
8. Adjust R83 for a minimum output measured from TP17 to TP12. This value must be less than 12 mV rms.
9. Set the calibrator to the thermocouple measure function, any type.

10. Short the TC jack + and - terminals.
11. Apply 10V at 60 Hz between the TC jacks and TP12.
12. Adjust R77 for a minimum output measured from TP40 to TP12. This value must be less than 3 mV rms.
13. Remove the jumper.

Access Procedures

This section explains how to access the following internal assemblies. Printed circuit assemblies are called PCAs.

- Display Assembly
- Lithium Battery (on Main PCA)
- Lens
- Keyboard PCA
- Elastomeric Keypad
- Main PCA
- Power Supply Assembly
- I/O PCA

Before you open the case, study Figures 3-17 and 3-18, which show how the internal assemblies fit together, and Figure 3-19, which shows where the interconnect cables go. Figure 3-19 does not show proper routing of the cables. Refer to the text for that information. Use a static-free work surface and wear an anti-static wrist strap.

Note

Overhauling electronic equipment is the same as the maintenance and repair instructions. Parts lists and their physical location are covered in the manual.

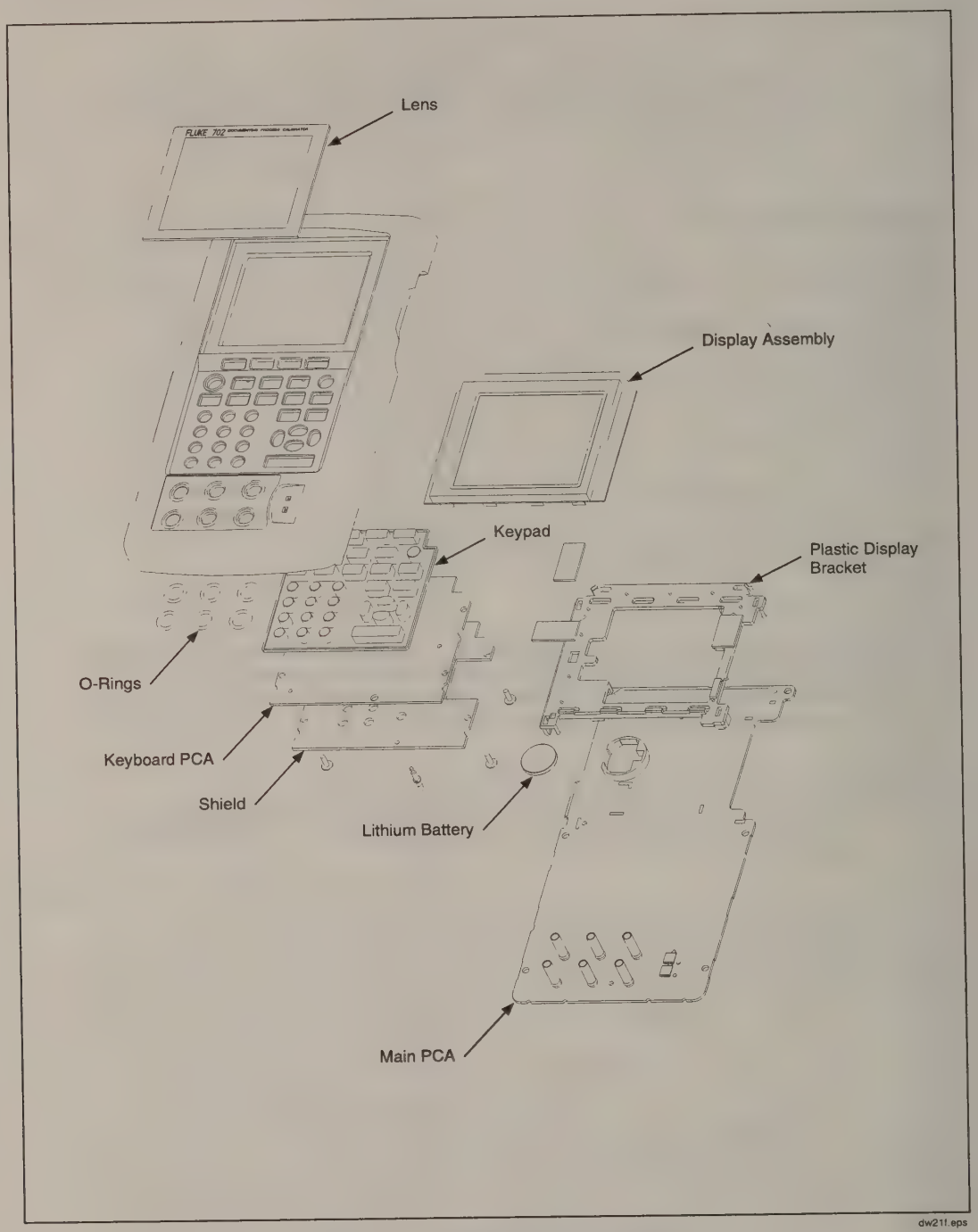

Figure 3-17. Exploded View, Top Half

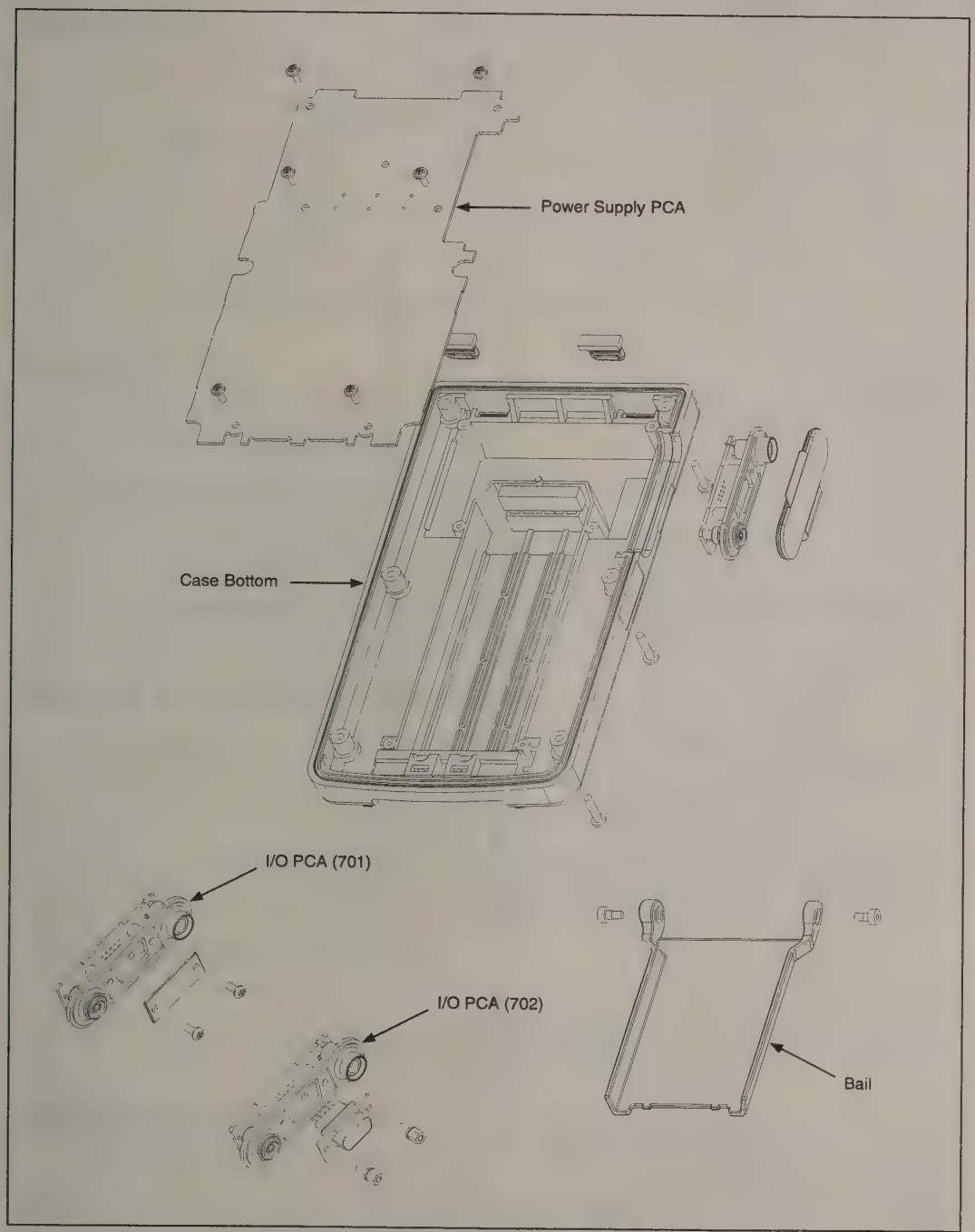

Figure 3-18. Exploded View, Bottom Half

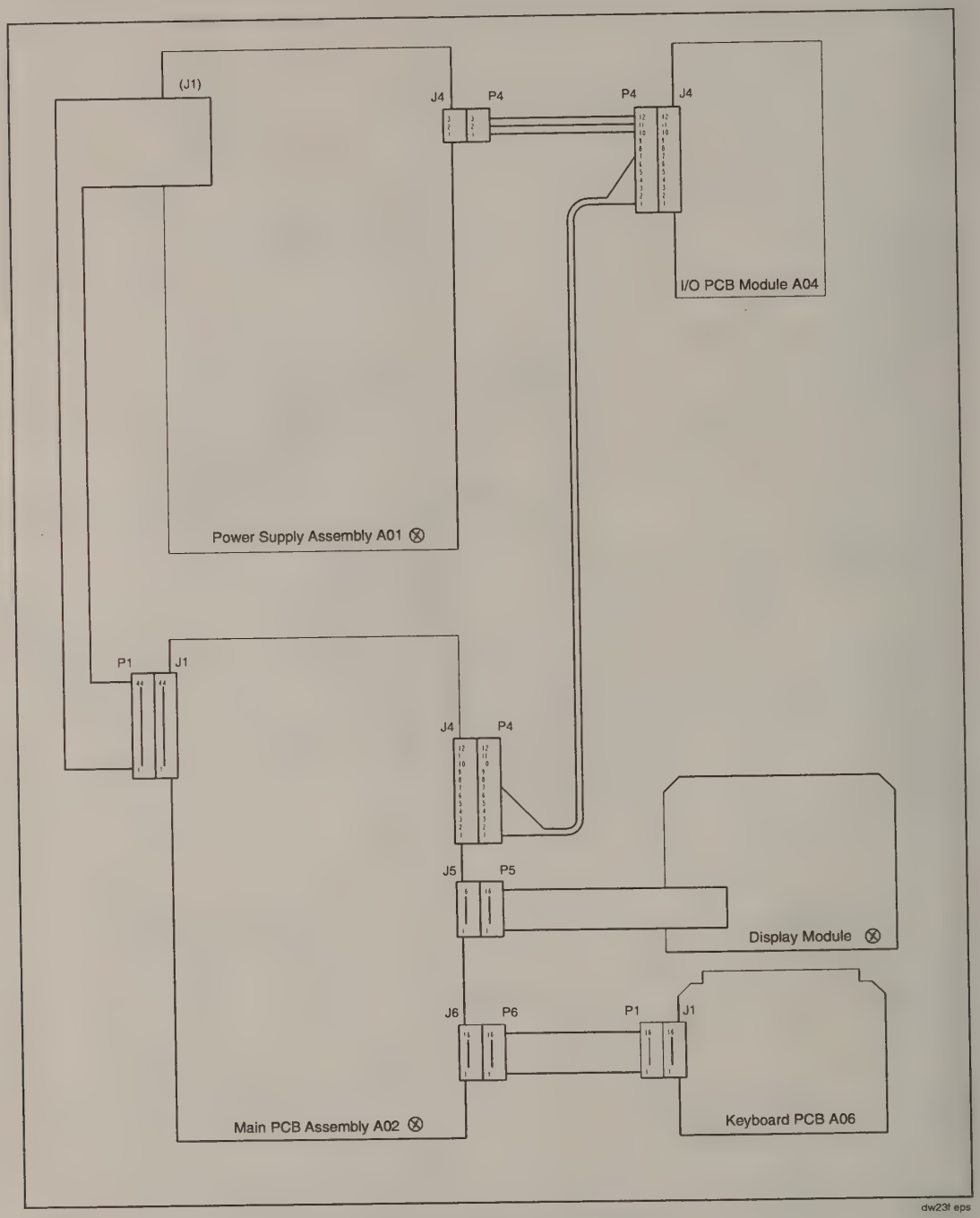

Figure 3-19. Interconnect Diagram

Required Tools

To access all the assemblies, you need the following:

- Static-free work surface.
- Antistatic wrist strap.
- #15 Torx screwdriver.
- Small flat screwdriver.
- Small Phillips screwdriver.
- Cotton gloves (to avoid fingerprinting the lens).

Opening the Case

Proceed as follows to open the case. This procedure gives you access to the Main PCA.

1. Remove the main battery.
2. Use the #15 Torx screwdriver to remove the six case screws.
3. Turn the calibrator over.
4. Open the calibrator like an upside down book (lift the right side).
5. Be careful not to lose any of the six O-rings that fit over the input/output jack plastic forms.

Removing the Display Assembly and Lens

There are no serviceable parts on the Display Assembly. Remove it as follows:

1. Gently pry loose the plastic frame that holds the Display Assembly to the Main PCA.
2. Lift the left side of the assembly to separate it from the Main PCA.
3. Remove the display flat cable from the Main PCA: Use a small flat screwdriver to gently pry loose the flat cable retainer bar on the flat cable connector on the Main PCA. Just loosen the bar, do not try to remove it completely.
4. Turn the Display Assembly over.
5. Remove it from the plastic frame.
6. To remove the lens, wear cotton gloves to prevent fingerprinting, and gently press the lens out from the inside. It is held in place by adhesive tape.

Removing the Lithium Battery

The lithium battery maintains the contents of RAM. If it is still providing 3V and you want to replace it for preventive maintenance, be aware that you will lose the contents of results and task memory. Setup parameters are maintained in Flash memory (U103), which does not require backup voltage.

1. Proceed as follows to replace the lithium battery:
2. Find the battery in the upper left of the Main PCA. It is a disc-type 3V battery.
3. Press the battery down and to the right with your finger.
4. The battery pops free of its clip.

Removing the Keyboard Assembly and Keypad

The Keyboard Assembly contains the Keyboard PCA and the keypad switches. The Keypad is a molded rubber part. Proceed as follows to remove the Keyboard PCA and Keypad:

1. First remove the flat ribbon cable that goes to the main PCA from the Keyboard PCA.
2. Remove the four small Phillips screws that fasten the metal shield and Keyboard Assembly to the top half of the case.
3. Lift off the shield and remove the Keyboard PCA and Keypad.

Removing the Main PCA

Proceed as follows to remove the Main PCA:

1. If you haven't already done so, remove the Display Assembly as previously described.
2. If the Keyboard PCA is still installed, unplug the Keyboard flat ribbon cable from the Main PCA.
3. Remove the I/O cable plug from the connector located on the upper right side of the Main PCA above the Display cable.
4. Gently pry the 44-pin plug from the Power Supply PCA from its connector at the upper left corner of the Main PCA.
5. Remove the Main PCA.

Removing the Power Supply PCA

Proceed as follows to remove the Power Supply PCA:

1. If you haven't already done so, remove the Main PCA as previously described.
2. Remove the six small Phillips screws that fasten the Power Supply PCA to the bottom half of the case.
3. Remove the Power Supply PCA.
4. Unplug the three-wire cable leading to the I/O PCA.

Removing the Connector Board (I/O PCA)

Proceed as follows to remove the I/O PCA.

1. If you haven't already done so, remove the Main PCA and the Power Supply PCA as previously described.
2. Remove the I/O PCA.

Reassembly Hints

The following hints will help you successfully reassemble a calibrator that is disassembled to the PCA level:

1. Prepare the bottom half:
   a. Reinstall the I/O Assembly with the coaxial battery eliminator jack on top.
   b. Route the I/O cable under the Power Supply PCA.
   c. Reattach the three-conductor cable from the I/O PCA to the Power Supply PCA (upper right).
   d. Reinstall the Power Supply PCA by inserting the bottom tabs on the board into place first. Do not reinstall the screws yet.
   e. Route the I/O cable through the notch in the uppermost left side of the Power Supply PCA.
   f. Reinstall the screws.
2. Reinstall the Main PCA:
   a. Plug the 44-pin connector from the Power Supply PCA into its connector on the Main PCA. Push the excess cable into the case bottom.
   b. Route the I/O cable between the Power Supply PCA and the Main PCA, and reconnect the cable to the upper right connector on the Main PCA. The cable is oriented with the notches facing up (solid body of plug down).
   c. Attach the Display Assembly to the plastic display bracket.
   d. Reattach the flat cable from the Display Assembly into its connector on the Main PCA.
   e. Press the Display Assembly in place on the top side of the Main PCA, while folding the flat cable under the Display and out of the way.
   f. Use a moist soft cloth to remove any fingerprints from the display.
   g. Reinstall the Main PCA, while checking to make sure that the I/O cable is not interfering with the board fully seating in place against the screw posts.
   h. Push the Display Assembly to the left to align it properly.
3. Prepare the top half:
   a. If you removed it, reinstall the lens. Clean the inside of the lens with a moist soft cloth if necessary.
   b. Lay the top case next to the right side of the bottom case to align the keyboard cable.
   c. Reinstall the Keypad, the Keyboard PCA, and the shield with the large square notch to the left, align the Keyboard PCA and shield on the alignment post, then reinstall the four small Phillips screws.
   d. Reattach the flat cable between the Keyboard PCA and the Main PCA.
4. Put the halves together:
   a. If the halves fit together correctly, reinstall the case screws, main battery, and battery door.
   b. If the halves do not fit together fully, separate them again and determine if there is a cable incorrectly routed or some other misalignment.

Troubleshooting

If the calibrator does not turn on at all, check to see if it is receiving power:

- Verify that the battery is charged.
- Remove and reinstall the battery and try again to turn it on.
- Dim the room lights or cup your hands around the display and watch for a flash of the backlight when you first press the power button. If you see the flash, the calibrator is receiving power. If there is no flash, the calibrator is not receiving power. Check the battery contacts for misalignment or corrosion; then check the flat keyboard cable. If there is a flash, but no flash with subsequent presses of the power button, the calibrator is receiving power but is locked up. This could be a soft error in Flash RAM or a failure in the display.

If a failure is isolated to a certain function, refer to Chapter 2 for theory of operation. A figure in Chapter 2 identifies areas on the main PCA that are associated with particular functions.

Components U103 and U105 on the main PCA are programmed devices that can only be replaced at an authorized Fluke Service Center.

Servicing Surface-Mount Components

The calibrator incorporates Surface-Mount Technology (SMT) for printed circuit assemblies. Surface-mount components are much smaller than their predecessors, with leads soldered directly to the surface of a circuit board; no plated through-holes are used. Unique servicing, troubleshooting, and repair techniques are required to support this technology.

Isolate the fault to a component before you replace a part. Probe surface-mount assemblies from the component side. The special probes make contact only with the pads in front of the component leads. With the close spacing involved, ordinary test probes can easily short two adjacent pins on an SMT IC. The Service Manual is a vital source for component locations and values.

With limited space, the circuit board chip component locations are seldom labeled. Figures in Chapter 4 of this manual provide this information. Also, remember that chip components are not individually labeled; keep any new or removed component in a labeled package.

Surface-mount components are removed and replaced by reflowing all the solder connections at the same time. Some special considerations follow:

- The recommended type of solder tool uses regulated hot air to melt the solder; there is no direct contact between the tool and the component.
- Surface-mount assemblies require rework with wire solder rather than with solder paste. A 0.025-inch diameter wire solder, composed of 63% tin and 37% lead is recommended. A 60/40 solder is also acceptable.
- A good connection with SMT requires only enough solder to make a positive metallic contact. Too much solder causes bridging, while too little solder can cause weak or open solder joints.
- With SMT, the anchoring effect of the through-holes is missing; solder provides the only means of mechanical fastening. Therefore, the pca must be especially clean to ensure a strong connection. An oxidized pca pad causes the solder to wick up the component lead, leaving little solder on the pad itself.

Chapter 4
List of Replaceable Parts

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Accessories	4-3
Manual Status Information	4-3
Newer Instruments	4-4
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Introduction

This chapter contains an illustrated list of replaceable parts for models 701 and 702 Documenting Process Calibrators. Parts are listed by assembly; alphabetized by reference designator. Each assembly is accompanied by an illustration showing the location of each part and its reference designator. The parts lists give the following information:

- Reference designator (for example, "R52")
- An indication if the part is subject to damage by static discharge
- Description
- Fluke stock number
- Total quantity
- Any special notes (i.e., factory-selected part)

CAUTION

A * symbol indicates a device that may be damaged by static discharge.

How To Obtain Parts

Electronic components may be ordered directly from the Fluke Corporation and its authorized representatives by using the part number under the heading Fluke Stock No. In the U.S., order directly from the Fluke Parts Dept. by calling 1-800-526-4731. Parts price information is available from the Fluke Corporation or its representatives.

In the event that the part ordered has been replaced by a new or improved part, the replacement will be accompanied by an explanatory note and installation instructions, if necessary.

To ensure prompt delivery of the correct part, include the following information when you place an order:

- Instrument model and serial number
- Part number and revision level of the pca (printed circuit assembly) containing the part.
- Reference designator
- Fluke stock number
- Description (as given under the Description heading)
- Quantity

Accessories

Refer to the *701/702 Users Manual* for information about accessories.

Manual Status Information

The Manual Status Information table that precedes the parts list defines the assembly revision levels that are documented in the manual. Revision levels are printed on the component side of each pca.

Newer Instruments

Changes and improvements made to the instrument are identified by incrementing the revision letter marked on the affected pca. These changes are documented on a supplemental change/errata sheet which, when applicable, is included with the manual.

Service Centers

To locate an authorized service center, call Fluke using any of the phone numbers listed below, or visit us on the World Wide Web: www.fluke.com

1-800-443-5853 in U.S.A and Canada

31 40 267 8200 in Europe

206-356-5500 from other countries

Ni-Cd *Note*

This instrument may contain a Nickel-Cadmium battery. Do not mix with the solid waste stream. Spent batteries should be disposed of by a qualified recycler or hazardous materials handler. Contact your authorized Fluke service center for recycling information.

MANUAL STATUS INFORMATION

Ref or Option number	Assembly name	Fluke Part Number	Revision Level
A1	Power Supply PCA	938279	E
A2	Main PCA	946780	M
A4	Connector PCA	946785	C
A5	Thermal PCA	938290	—
A6	Keyboard PCA	946665	—

Table 4-1. 701/702 Final Assembly

Reference Designator		Description	Fluke Stock No	Tot Qty	Notes
A1	*	POWER SUPPLY PCA	938279	1	
A2	*	701 MAIN PCA	946780	1	2
A4	*	701 CONNECTOR PCA	946785	1	2
A2	*	702 MAIN PCA	938282	1	3
A4	*	702 CONNECTOR PCA	938287	1	3
A5	*	THERMAL PCA	938290	1	
A6	*	KEYBOARD PCA	946665	1	
BT1		BATTERY,LITHIUM,3.0V,0.18AH	929369	1	
H1		SCREW,BTNH,T,SS,M3.5X16	942797	6	
H7		SCREW,CAP,SCKT,SHLDR,SS,6-32,.1250	943431	2	
H13		SCREW,PH,P,THD FORM,STL,5-20,.312	494641	10	
MP3		TOP CASE	938345	1	
MP4		BOTTOM CASE	938352	1	
MP5		702 LENS/DECAL	938212	1	1
MP6		701 LENS/DECAL	938217	1	2
MP7		LCD MODULE,240X200 GRAPH,TRNSFLECTIVE	944967	1	
MP8		BATTERY DOOR	938357	1	
MP9		BAIL	938340	1	
MP10		SIDE PLUG	938274	1	
MP11		KEYPAD (MOLDED RUBBER)	938209	1	
MP12		STRAP KEEPER	938261	2	
MP14		BATTERY PACK ASSY	938170	1	
MP15		BANANA PLUG,MINI,PANEL,4-40,GOLD	943696	1	
MP17		KEYBOARD BRACKET	938241	1	
MP19		BATTERY PAD	949441	2	
MP21		CABLE,FLAT,JUMPER,16COND,.039SP,2.5	942636	1	
MP24		I/O CABLE	946764	1	
MP25		LABEL,ADHES,VINYL,BAR CODE,1.500,.312	844712	1	
MP33		TOP CASE DECAL, 701/702	946756	1	
MP65		O-RING,NITRILE,.366,.070	929815	6	
MP71		INSULATOR,INPUT RECEPTACLE (RED)	884254	3	
MP74		INSULATOR,INPUT RECEPTACLE (BLACK)	884259	3	
MP77		DISPLAY BRACKET	946681	1	
MP103		CABLE ACCESS,TIE,4.00L,.10W,.75 DIA	172080		
MP105		TAPE,FOAM,URETHANE,.063,.500,1.000	854539	3	
MP203		STRAP, 701/702	946769	1	
MP210		CORD,LINE,CONT EURO,2.5M,10A,250V	769422	1	4
MP404		BATT CHARGER,NI-CD,7.2V,1A,15VDC (FOR INT'L)	943746	1	4
MP405		PWR SUP,15W,15V@1A	944223	1	4
MP406		BATT CHARGER,NI-CD,7.2V,1A,120VAC (FOR NORTH AM.)	943741	1	4
TM1		USER MANUAL ENG/FR/SP	942792	1	
TM2		QUICK REFERENCE CARD (MULTI-LINGUAL SET)	942784	1	
TM3		USERS MANUAL,ENG/GER/IT	943147	1	4
TM4		BC7210 INSTRUCTION SHEET,INTL	944020	1	

NOTES:
1. 702, 702 INTL, 702+ AND 702+ INTL ONLY.
2. 701 AND 701 INTL ONLY.
3. 702+ AND 702+ INTL ONLY.
4. INTL ONLY.

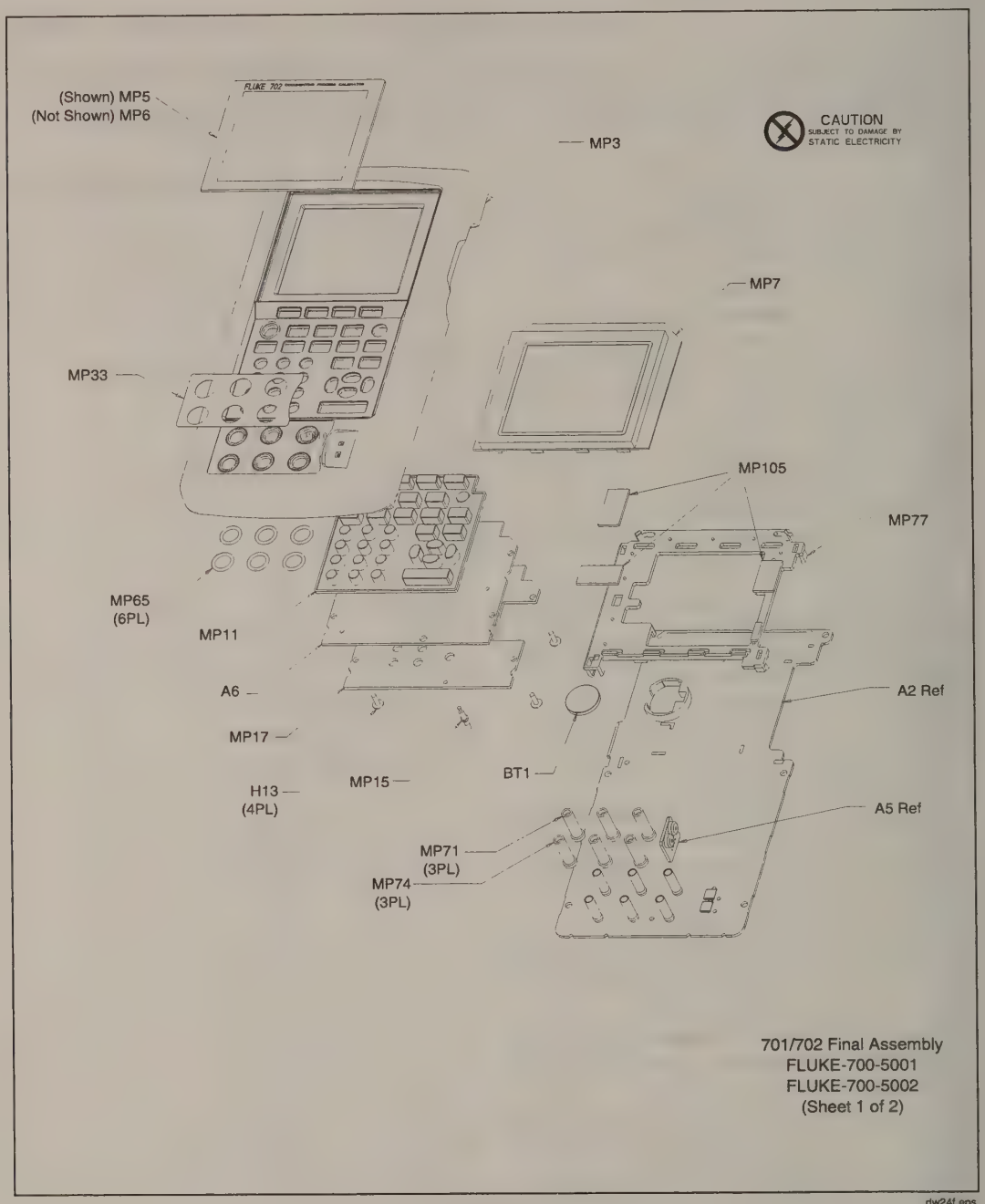

Figure 4-1. 701/702 Final Assembly

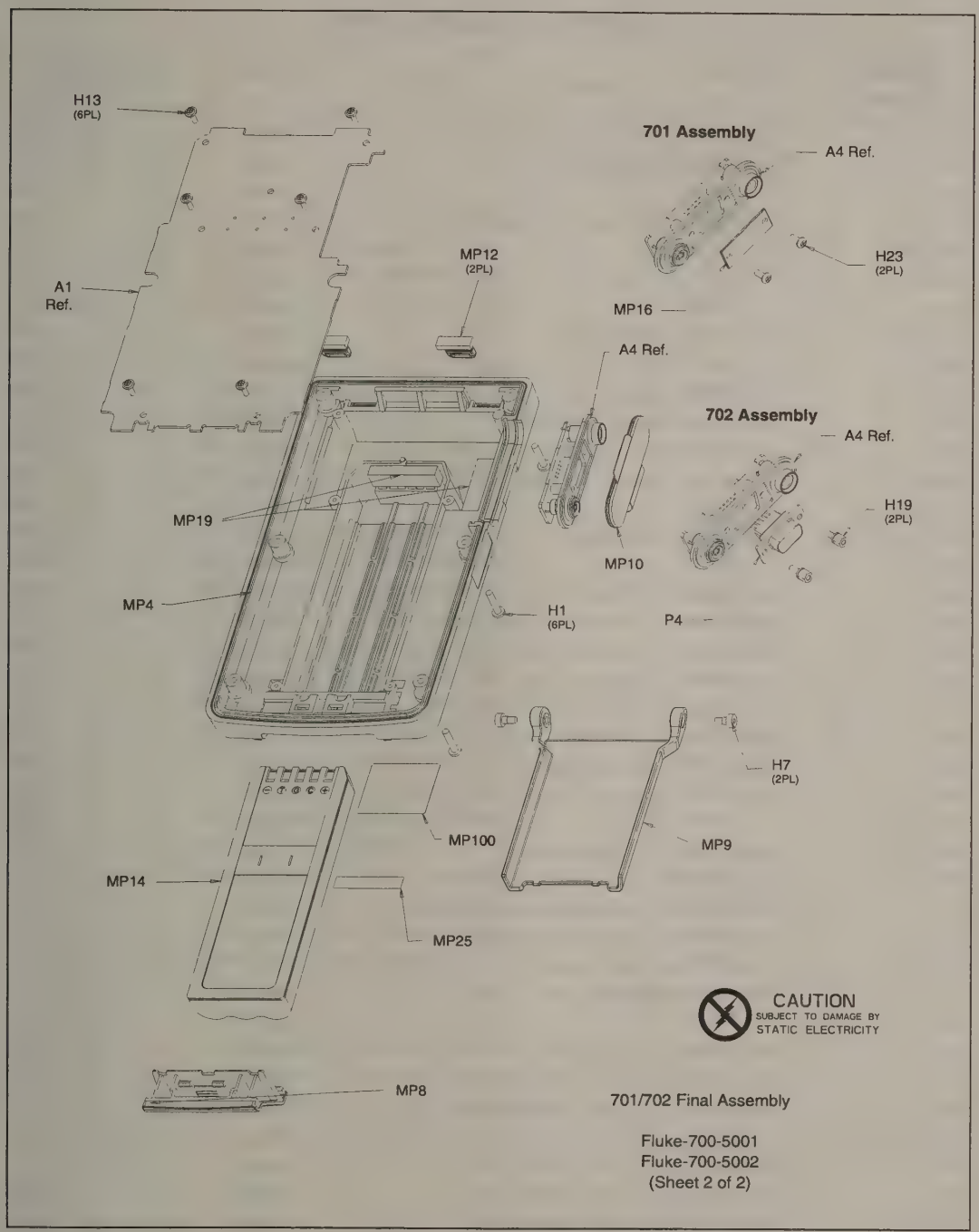

Figure 4-1. 701/702 Final Assembly (cont)

Table 4-2. A1 Power Supply PCA

Reference Designator		Description	Fluke Stock No	Tot Qty	Notes
BC1, 3, 5		CONTACT, PWB BATTERY INTERFACE	938303	3	
C1, 8, 22,		CAP,TA,22UF,+-20%,6V,6032	876545	5	
C28, 47			876545		
C2, 4, 12,		CAP,CER,0.22UF,+80-20%,50V,Y5V,1206	740597	10	
C13, 20, 23,			740597		
C25, 26, 32,			740597		
C50			740597		
C3, 10, 11,		CAP,TA,10UF,+-20%,25V,6032	927814		
C27			927814		
C5, 46		CAP,TA,4.7UF,+-20%,50V,7343	943589	2	
C6		CAP,CER,0.01UF,+-20%,100V,X7R,1206	742981	1	
C7, 29		CAP,CER,1000PF,+-10%,50V,C0G,1206	747378	2	
C9, 18, 19,		CAP,CER,100PF,+-10%,50V,C0G,1206	740571	5	
C30, 45			740571		
C14- 17, 34-		CAP,TA,3.3UF,+-20%,16V,3528	876552	13	
C40, 42, 48			876552		
C21		CAP,CER,220PF,+-10%,50V,C0G,1206	758078	1	
C24		CAP,CER,1800PF,+-10%,50V,C0G,1206	769786	1	
C31		CAP,CER,33PF,+-10%,50V,C0G,1206	769240	1	
C33, 41, 43		CAP,CER,0.1UF,+-10%,25V,X7R,1206	747287	3	
C44		CAP,CER,0.027UF,+-5%,50V,X7R,1206	811687	1	
CR1		DIODE,SI,200 PIV,1 A,ULTRAFAST	944264	1	
CR2- 5, 12		DIODE,SI,30 PIV,1.1 AMPS,SCHOTTKY	782573	5	
CR6- 8, 11,	*	DIODE,SI,BV=70V,IO=50MA,DUAL,SOT23	742320	6	
CR13, 16	*		742320		
CR9, 10, 15	*	DIODE,SI,BV=75V,IO=250MA,SOT23	830489	3	
CR18	*	DIODE,SI,BV=200V,IO=200MA,350MW,SOT23	867072	1	
J1		CABLE ASSY,FLAT,44 COND,2ROW SCKT,PWB	943469	1	
J2		HEADER,1 ROW,1.25MM CTR,RT ANG,3 PIN	943758	1	
L1, 3		INDUCTOR,100UH,+-20%,0.51ADC	929211	2	
Q1, 8, 10,	*	TRANSISTOR,SI,NMOS,1W,D-PAK	822106	4	
Q11	*		822106		
Q2, 5	*	TRANSISTOR,SI,PMOS,1W,D-PAK	836544	2	
Q3	*	TRANSISTOR,SI,N-DMOS FET,SOT-23	927538	1	
Q4, 7, 9,	*	TRANSISTOR,SI,NPN,SMALL SIGNAL,SOT-23	742676	5	
Q12, 13	*		742676		
Q6, 15	*	TRANSISTOR,SI,PNP,SMALL SIGNAL,SOT-23	742684	2	
R1	*	RES,CERM,100,+-1%,.125W,100PPM,1206	867494	1	
R2	*	RES,CERM,402K,+-1%,.125W,100PPM,1206	877006	1	
R3, 7, 18	*	RES,CERM,43.2K,+-1%,.125W,100PPM,1206	887109	3	
R4	*	RES,CERM,324K,+-1%,.125W,100PPM,1206	911243	1	
R5, 26, 44	*	RES,CERM,1M,+-1%,.125W,100PPM,1206	836387	3	
R6, 13, 19,	*	RES,CERM,10K,+-1%,.125W,100PPM,1206	769794	10	

Table 4-2. A1 Power Supply PCA (cont)

Reference Designator		Description	Fluke Stock No	Tot Qty	Notes
R31, 32, 37,	*		769794		
R39, 40, 54,	*		769794		
R57	*		769794		
R8, 53	*	RES,CERM,11K,+-1%,.125W,100PPM,1206	867291	2	
R9, 16		RES,MF,2.7,+-5%,0.125W,200PPM	929310	2	
R10, 35	*	RES,CERM,220,+-5%,.125W,200PPM,1206	746347	2	
R11, 29, 46-	*	RES,CERM,40.2K,+-1%,.125W,100PPM,1206	867692	6	
R49	*		867692		
R12, 50, 52,	*	RES,CERM,100K,+-1%,.125W,100PPM,1206	769802	4	
R55	*		769802		
R15		RES,MF,16.5,+-1%,0.125W,50PPM	447011	1	
R17, 60	*	RES,CERM,16.9K,+-1%,.125W,100PPM,1206	836635	2	
R20, 41- 43,	*	RES,CERM,1K,+-1%,.125W,100PPM,1206	783241	5	
R58	*		783241		
R21, 22	*	RES,CERM,24.9K,+-1%,.125W,100PPM,1206	867689	2	
R23, 24	*	RES,CERM,432,+-1%,.125W,100PPM,1206	811885	2	
R25	*	RES,CERM,150K,+-1%,.125W,100PPM,1206	867697	1	
R27	*	RES,CERM,115K,+-1%,.125W,100PPM,1206	866830	1	
R28	*	RES,CERM,47,+-5%,.125W,200PPM,1206	746263	1	
R30, 34	*	RES,CERM,75K,+-1%,.125W,100PPM,1206	867085	2	
R33	*	RES,CERM,665K,+-1%,.125W,100PPM,1206	867460	1	
R36	*	RES,CERM,3.32K,+-1%,.125W,100PPM,1206	810788	1	
R38	*	RES,CERM,10,+-1%,.125W,100PPM,1206	867676	1	
R45, 56	*	RES,CERM,226K,+-1%,.125W,100PPM,1206	876524	2	
R51	*	RES,CERM,280K,+-1%,.125W,100PPM,1206	886833	1	
T1		SWITCHING TRANSFORMER	938175	1	
U1	*	IC,VOLT REG,FIXED,+5V,UPOWR,LO DO,SO8	929190	1	
U2, 6	*	IC,VOLT REG,SWITCHING,100KHZ,1.2A,SO8	944249	2	
U3, 8	*	IC,OP AMP,DUAL,HIGH BW,SNGL SUP,SO8	929075	2	
U4	*	IC,CMOS,DUAL D F/F,+EDG TRG,SOIC	782995	1	
U5, 9	*	IC,VOLT REG,5 V,500 MA,LO DO,TO-263	942693	2	
U7	*	IC,OP AMP,DUAL,LOW POWER,SOIC	867932	1	
VR1,4	*	ZENER,UNCOMP,22V,5%,5.6MA,0.2W,SOT-23	831230	2	
VR2	*	ZENER,UNCOMP,5.6V,5%,20MA,0.2W,SOT-23	875604	1	
VR3	*	ZENER,UNCOMP,36V,5%,3.4MA,0.2W,SOT-23	943456	1	
VR5	*	ZENER,UNCOMP,6.8V,5%,20MA,0.2W,SOT-23	837195	1	

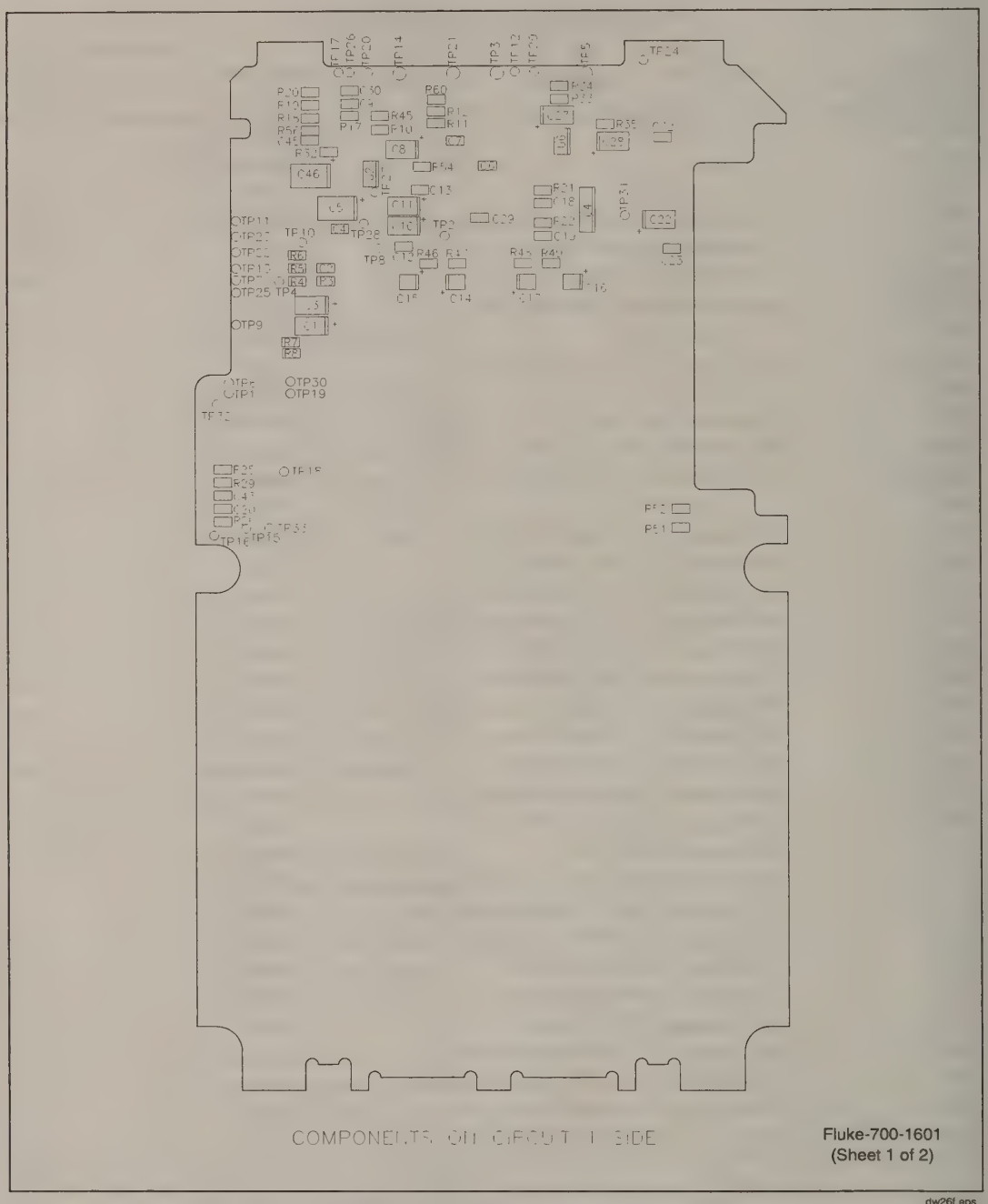

Figure 4-2. A1 Power Supply PCA

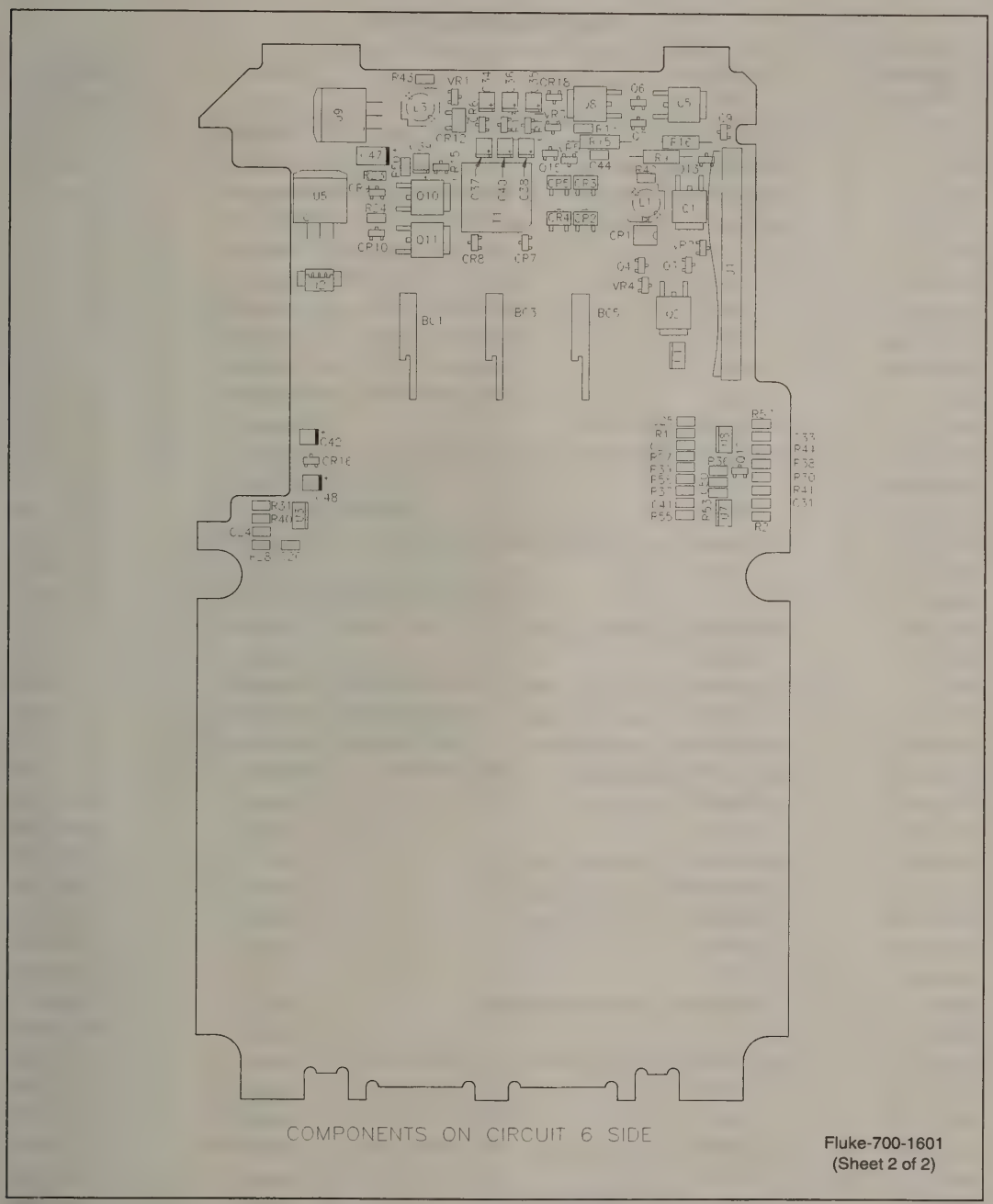

Figure 4-2. A1 Power Supply PCA (cont)

Table 4-3. A2 Main PCA

Reference Designator	Description	Fluke Stock No	Tot Qty	Notes
BP1- 6	TERMINAL POST	938196	6	
BT1	BATTERY,LITHIUM,3.0V,0.18AH	929369	1	
BT991	HOLDER,BATTERY,PWB,2032 COIN	929448	1	
C1, 2, 6,	CAP,CER,0.22UF,+80-20%,50V,Y5V,1206	740597	78	
C10, 19, 23,		740597		
C27, 31, 32		740597		
C35, 49, 50,		740597		
C103,117,136-		740597		
C181,183-190,		740597		
C193		740597		
C3	CAP,TA,47UF,+-20%,10V,7343	867580	1	
C4, 7,101,	CAP,CER,22PF,+-10%,50V,C0G,1206	740563	8	
C102,110,182,		740563		
C191,192		740563		
C5, 13, 15,	CAP,CER,0.01UF,+-20%,100V,X7R,1206	742981	8	
C24, 38, 42,		742981		
C106,115		742981		
C8, 11,210-	CAP,CER,220PF,+-10%,50V,C0G,1206	758078	6	
C213		758078		
C9	CAP,CER,47PF,+-10%,50V,C0G,1206	747352	1	
C12, 18,132	CAP,CER,33PF,+-10%,50V,C0G,1206	769240	3	
C14,111,112,	CAP,CER,0.01UF,+-5%,50V,C0G,1812	929364	3	
C16,120,200	CAP,TA,10UF,+-20%,25V,6032	927814	3	
C17, 21, 26,	CAP,TA,22UF,+-20%,6V,6032	876545	5	
C118,119		876545		
C34, 36, 37	CAP,CER,10PF,+-10%,50V,C0G,1206	747311	3	
C22, 28	CAP,CER,0.027UF,+-5%,50V,X7R,1206	811687	2	
C25,113,129,	CAP,CER,0.1UF,+-10%,25V,X7R,1206	747287	9	
C130,133,134,		747287		
C201-203		747287		
C29, 30, 33	CAP,CER,4700PF,+-10%,50V,X7R,1206	832279	4	
C135		832279		
C20, 39- 41	CAP,CER,100PF,+-10%,50V,C0G,1206	740571	8	
C104,105,220,		740571		
C221		740571		
C43, 44,206,	CAP,CER,4.3PF,+-10%,50V,C0G,1206	844738	4	
C207		844738		
C45- 48	CAP,CER,1000PF,+-10%,50V,C0G,1206	747378	4	
C116	CAP,CER,0.022UF,+-10%,50V,X7R,1206	747279	1	
C122,123	CAP,POLYPR,0.047UF,+-10%,100V	867093	2	
C124	CAP,CER,390PF,+-5%,50V,COG,1206	887278	1	
C125	CAP,TA,1.5UF,+-20%,50V,6032	929302	1	
C127,128	CAP,CER,15PF,+-10%,50V,C0G,1206	837393	2	
C126	CAP,POLYRP,0.03UF,+-10%,63V	721050	1	
C214	CAP,CER,0.047UF,+-20%,50V,X7R,1206	782615	1	
CR1	* DIODE,SI,DUAL,BV=50V,IO=100MA,SOT23	851659	1	

Table 4-3. A2 Main PCA (cont)

Reference Designator		Description	Fluke Stock No	Tot Qty	Notes
CR100,106	*	DIODE,SI,BV=75V,IO=250MA,SOT23	830489	2	
CR102,105,107	*	DIODE,SI,BV=70V,IO=50MA,DUAL,SOT23	742320	3	
CR103,104	*	DIODE,SI,BV=200V,IO=200MA,350MW,SOT23	867072	2	
F1		FUSE,.095X.28,0.5A,125V,FAST,AXIAL	603274	1	
J1		HEADER,2 ROW,2MMCTR,RT ANG,44 PIN	943472	1	
J4		HEADER,1 ROW,1.25MM CTR,RT ANG,12 PIN	943753	1	
J5, 6		CONN,FLAT FLEX,1MM CTR,RT ANG,16 POS	929229	2	
K1, 2, 4		RELAY,ARMATURE,2 FORM C,5VDC,LATCH	942917	3	
K3		RELAY,ARMATURE,2 FORM C,5V,LATCH	875356	1	
L1- 3, 13-		FERRITE CHIP,600 OHM @100 MHZ,1206	943704	7	
L16			943704		
L11, 12		FERRITE CHIP,95 OHMS @100 MHZ,3612	867734	2	
LS1		AF TRANSD,PIEZO,20MM,2KHZ	876995	1	
MP1, 2		CONTACT, THERMOCOUPLE	745802	2	
Q1, 5, 6,	*	TRANSISTOR,SI,NPN,SMALL SIGNAL,SOT-23	742676	4	
Q106	*		742676		
Q2,100,107	*	TRANSISTOR,SI,PNP,SMALL SIGNAL,SOT-23	742684	3	
Q3, 4, 7,	*	TRANSISTOR,SI,N-JFET,SOT-23	876263	4	
Q8	*		876263		
Q104	*	TRANSISTOR,SI,PMOS,1W,D-PAK	836544	1	
Q105	*	TRANSISTOR,SI,N-DMOS,500V,TO-92	782490	1	
Q108	*	TRANSISTOR,SI,P-MOS,500V,TO-92	782508	1	
R1, 5, 9,	*	RES,CERM,10K,+-1%,.125W,100PPM,1206	769794	30	
R17, 24, 38,	*		769794		
R57, 64, 69,	*		769794		
R72, 73, 80,	*		769794		
R81,105,107,	*		769794		
R108,111,113,	*		769794		
R115,116,120,	*		769794		
R129,142,147,	*		769794		
R150,167,219,	*		769794		
R220,233,239,	*		769794		
R2, 6, 86,	*	RES,CERM,20K,+-1%,.125W,100PPM,1206	927421	4	
R87	*		927421		
R3	*	RES,CERM,14K,+-1%,.125W,100PPM,1206	816033	1	
R4, 10, 16,	*	RES,CERM,1K,+-1%,.125W,100PPM,1206	783241	11	
R26, 46, 50,	*		783241		
R66,112,128,	*		783241		
R168,175	*		783241		
R7, 8, 15,	*	RES,CERM,100K,+-1%,.125W,100PPM,1206	769802	23	
R25, 28, 31,	*		769802		
R32, 40, 49,	*		769802		
R52, 53, 68,	*		769802		
R74, 75,118,	*		769802		
R119,122-127,	*		769802		
R235	*		769802		

Table 4-3. A2 Main PCA (cont)

Reference Designator		Description	Fluke Stock No	Tot Qty	Notes
R11, 58, 61,	*	RES,CERM,4.02K,+-1%,.125W,100PPM,1206	783266	12	
R156,162,183,	*		783266		
R185,187,208,	*		783266		
R224,225,236	*		783266		
R12	*	RES,CERM,101%,.125W,100PPM,1206	867676	1	
R13, 59, 63	*	RES,CERM,5.62K,+-1%,.125W,100PPM,1206	837047	3	
R14, 44, 62,	*	RES,CERM,2K,+-1%,.125W,100PPM,1206	807172	13	
R106,109,110,	*		807172		
R121,161,206,	*		807172		
R209,212,215,	*		807172		
R223	*		807172		
R18, 33, 76	*	RES,CERM,200K,+-5%,.125W,200PPM,1206	746743	4	
R86	*		746743		
R19, 20	*	RES,CERM,56.2K,+-1%,.125W,100PPM,1206	831305	2	
R21,135,155,	*	RES,CERM,49.9K,+-1%,.125W,100PPM,1206	836379	4	
R237	*		836379		
R22, 36, 42,	*	RES,CERM,412K,+-1%,.125W,100PPM,1206	875229	4	
R141	*		875229		
R23, 54, 55,	*	RES,CERM,30.1K,+-1%,.125W,100PPM,1206	801258	5	
R78, 79	*		801258		
R27, 71,148,	*	RES,CERM,275%,.125W,200PPM,1206	807735	4	
R151	*		807735		
R29, 70,182	*	RES,CERM,100,+-1%,.125W,100PPM,1206	867494	3	
R30, 45	*	RES,CERM,499K,+-1%,.125W,100PPM,1206	821678	2	
R34,180,181	*	RES,CERM,40.2K,+-1%,.125W,100PPM,1206	867692	3	
R35,171	*	RES,CERM,562K,+-1%,.125W,100PPM,1206	867432	2	
R37,145,146,	*	RES,CERM,226K,+-1%,.125W,100PPM,1206	876524	5	
R149,152	*		876524		
R39	*	RES,CERM,10K,+-5%,.125W,200PPM,1206	746610	1	
R41,102,114,	*	RES,CERM,1M,+-1%,.125W,100PPM,1206	836387	4	
R117	*		836387		
R43, 47,186,	*	RES,CERM,43.2K,+-1%,.125W,100PPM,1206	887109	6	
R188,197,213	*		887109		
R48,176	*	RES,CERM,24.9K,+-1%,.125W,100PPM,1206	867689	2	
R51	*	RES,CERM,15M,+-5%,.125W,300PPM,1206	811968	1	
R56,103,104	*	RES,CERM,150K,+-1%,.125W,100PPM,1206	867697	3	
R60,172	*	RES,CERM,61.9K,+-1%,.125W,100PPM,1206	821330	2	
R65,159,160,	*	RES,CERM,432,+-1%,.125W,100PPM,1206	811885	5	
R184,234	*		811885		
R67	*	RES,CERM,11K,+-1%,.125W,100PPM,1206	867291	1	
R77		RES,VAR,CERM,10K,+-25%	944835	1	
R82, 83		RES,VAR,CERM,50K,+-25%	928093	2	
R84		RES,CERM,10M,+-5%,.125w,300PPM,1206	783274	1	
R101,157,158,	*	RES,CERM,1.5K,+-1%,.125W,100PPM,1206	810630	7	
R207,210,211,	*		810630		
R214	*		810630		

Table 4-3. A2 Main PCA (cont)

Reference Designator		Description	Fluke Stock No	Tot Qty	Notes
R137	*	RES,CERM,158K,+-1%,.125W,100PPM,1206	851568	1	
R139	*	RES,CERM,174K,+-1%,.125W,100PPM,1206	876008	1	
R140	*	RES,CERM,75K,+-1%,.125W,100PPM,1206	867085	1	
R143	*	RES,CERM,1.87K,+-1%,.125W,100PPM,1206	822312	1	
R154		RES,BMF,121,+-1%,0.25W,4PPM	943555	1	
R166	*	RES,CERM,1.5M,+-1%,.125W,200PPM,1206	821181	1	
R169	*	RES,CERM,665K,+-1%,.125W,100PPM,1206	867460	1	
R170	*	RES,CERM,280K,+-1%,.125W,100PPM,1206	886833	1	
R173	*	RES,CERM,16.9K,+-1%,.125W,100PPM,1206	836635	1	
R174	*	RES,CERM,845,+-1%,.125W,100PPM,1206	821322	1	
R201		RES,WW,1K,+-1%,1.5W,20PPM,2514	944970	1	
R202		RES,BMF,10,+-1%,0.25W,4PPM	944038	1	
R226-232	*	RES,CERM,475%,.125W,200PPM,1206	746263	7	
R238	*	RES,CERM,220,+-5%,.125W,200PPM,1206	746347	1	
U1,117,129	*	IC,OP AMP,DUAL,LOW POWER,SOIC	867932	3	
U2	*	IC,OP AMP,CHOPPER,DUAL,INT CAPS,SO8	929315	1	
U3,141,144,	*	ISOLATOR,OPTO,LED TO TRANSISTOR,SOIC	942680	4	
U146	*		942680		
U4	*	IC,CMOS,COMPARATOR,DUAL,UPOWER,SO8	913835	1	
U100	*	IC,CMOS,INTEGRATED MPU,16 MHZ,PQFP132	929083	1	
U101,102	*	IC,CMOS,SRAM,128K X 8,100 NS,SO32	914101	2	
U103	*	IC,FLASH,256K X 16,PROGRAMMED,SO44	943126	1	1
U105		IC,EEPROM,SERIAL,256 X 16,4K BIT,SO8	929252	1	1
U106	*	IC,CMOS,PARALLEL I/O CAL/CLCK W/CRYST	914036	1	
U107	*	IC,GRAPHIC LCD CONTROLLER,3 V,60QFP	929208	1	
U108	*	IC,SRAM,32K X 8,LOW ICCDR,120 NS,SO28	929351	1	
U109-112	*	IC,CMOS,QUAD BUFFER W/3-ST,SOIC	852090	4	
U113	*	IC,CMOS,QUAD BUS BUFFER W/3-ST,SOIC	866801	1	
U114	*	IC,CMOS,MICROPROCESSOR SUPERVISOR,SO8	929224	1	
U115	*	IC,PROG INTERVAL TIMER,10 MHZ,PLCC28	911032	1	
U118	*	IC,2.5V,40 PPM T.C.,BANDGAP REF,SOIC	807040	1	
U119,148,166	*	IC,CMOS,8BIT SHFT RGS W/3-ST,SOIC	929273	3	
U120	*	IC,CMOS,DUAL D F/F,+EDG TRG,SOIC	782995	1	
U121	*	IC,CMOS,8 BIT SER DAC,1 LSB,SOIC	929299	1	
U122,123	*	IC,CMOS,HEX INVERTER W/SCHT TRIG,SOIC	876813	2	
U124	*	IC,OP AMP,DUAL,HIGH BW,SNGL SUP,SO8	929075	1	
U125	*	IC,CMOS,QUAD BILATERAL SWITCH,SOIC	944202	1	
U126,130,134	*	IC,CMOS,QUAD BILATERAL SWITCH,SOIC	942701	5	
U135,150	*		942701		
U127	*	IC,CMOS,QUAD 2 INPUT NAND GATE,SOIC	838177	1	
U128	*	IC,CMOS,12 BIT SER MLTPLYING DAC,SOIC	929294	1	
U131,133,160,	*	IC,OP AMP,CHOPPER,DUAL,INT CAPS,8PDIP	929539	4	
U161	*		929539		
U136,149	*	IC,OP AMP,DUAL,JFET,LOW POWER,SOIC	806794	2	
U137	*	IC,BPLR,TRUE RMS TO DC CONVERTER,SOIC	868000	1	
U138,159	*	IC,VOLT REG,FIXED,+5V,UPOWR,LO DO,SO8	929190	2	

Table 4-3. A2 Main PCA (cont)

Reference Designator		Description	Fluke Stock No	Tot Qty	Notes
U140		MERCURY/SATURN, ASSY TESTED PLASTIC.	776195	1	
U142,143,152,	*	ISOLATOR,OPTO,LED TO DARLINGTON,SOIC	929286	7	
U153,155,156,	*		929286		
U162	*		929286		
U145,147,154	*	ISOLATOR,OPTO,LED TO TRANSISTOR,SOIC	929281	3	
U151,165	*	IC,CMOS,8-1 LINE MUX ANALOG SW,SOIC	929278	2	
U157	*	IC,CMOS,RS232 DRIVER/RECEIVER,SOIC	821538	1	
U158	*	IC,CMOS,QUAD INPUT NOR GATE,SOIC	830711	1	
U163,164	*	IC,VOLTAGE REF,7 V,+-50 MV,10 PPM,SO8	942698	2	
VR1	*	ZENER,UNCOMP,4.7V,5%,20MA,0.2W,SOT-23	945043	1	
VR2	*	ZENER,UNCOMP,3.3V,5%,20MA,0.2W,SOT-23	807008	1	
VR3, 4	*	ZENER,UNCOMP,15V,5%,8.5MA,0.2W,SOT-23	837187	2	
VR102,103	*	ZENER,UNCOMP,6.8V,5%,20MA,0.2W,SOT-23	837195	2	
VR104,105	*	ZENER,UNCOMP,6.0V,5%,20MA,0.2W,SOT-23	837161	2	
Y1		CRYSTAL,3.84MHZ,50PPM,SURFACE MT	929245	1	
Y2		CRYSTAL,3.6864MHZ,50PPM,SURFACE MT	929240	1	
Y3		CRYSTAL,10MHZ,50PPM,SURFACE MT	943105	1	
Z1, 2, 7,		RNET,MF,POLY,SIP,8840 LO V DIVIDER	655811	4	
Z10			655811		
Z3		RNET,MF,POLY,SIP,FLUKE 45 A TO D CONV	833921	1	
Z4, 5		RNET, MF, POLY, DIP, HI V INST AMP	900451	2	
Z6		RNET, MF, POLY, DIP, LO V INST AMP	103143		
Z11, 12		RNET,MF,POLY,SIP,1752 LO V DIVIDER	645341	2	

NOTE 1: UNPROGRAMMED PART..FOR AUTHORIZED FLUKE SERVICE CENTERS REPLACEMENT ONLY.

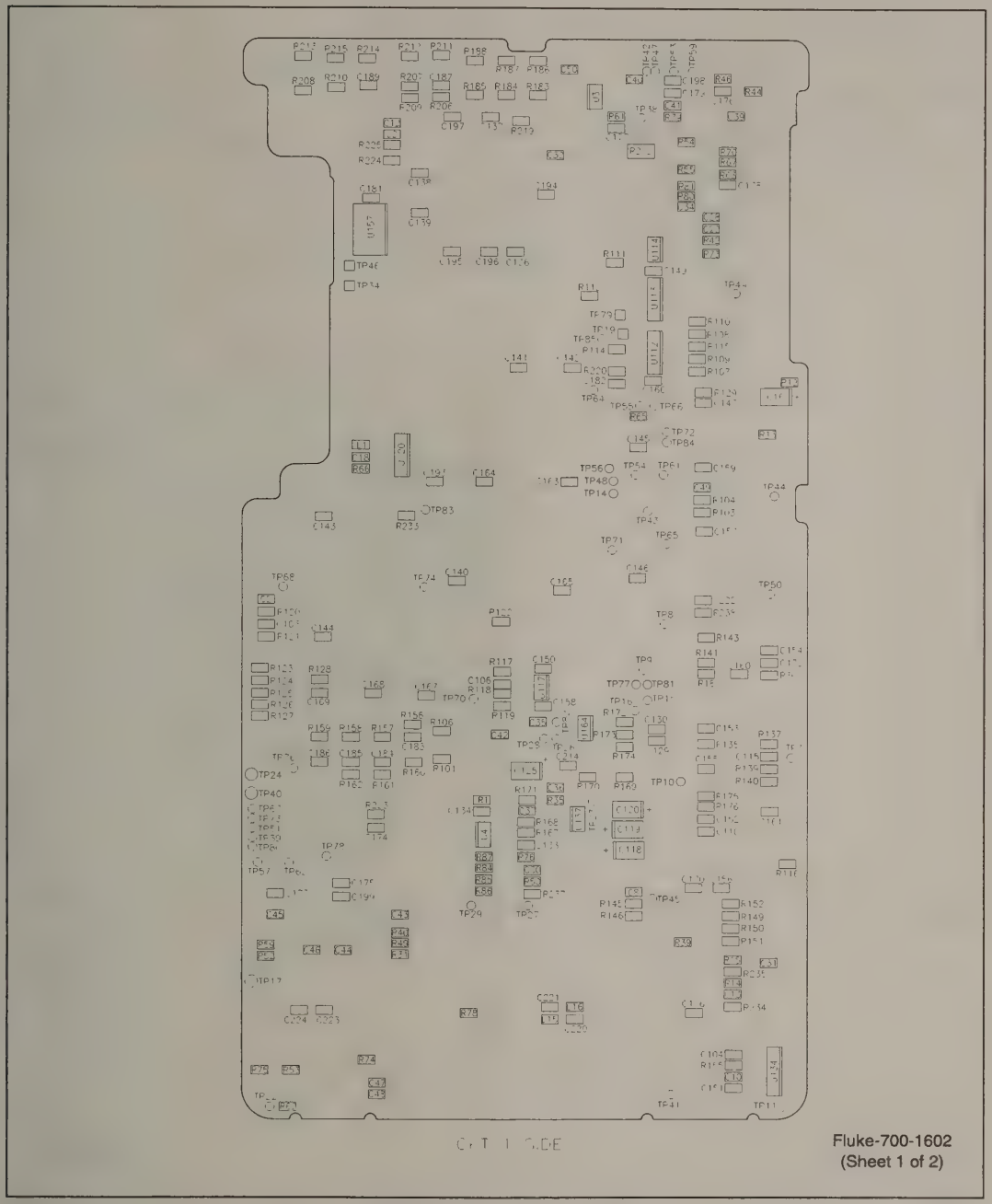

Figure 4-3. A2 Main PCA

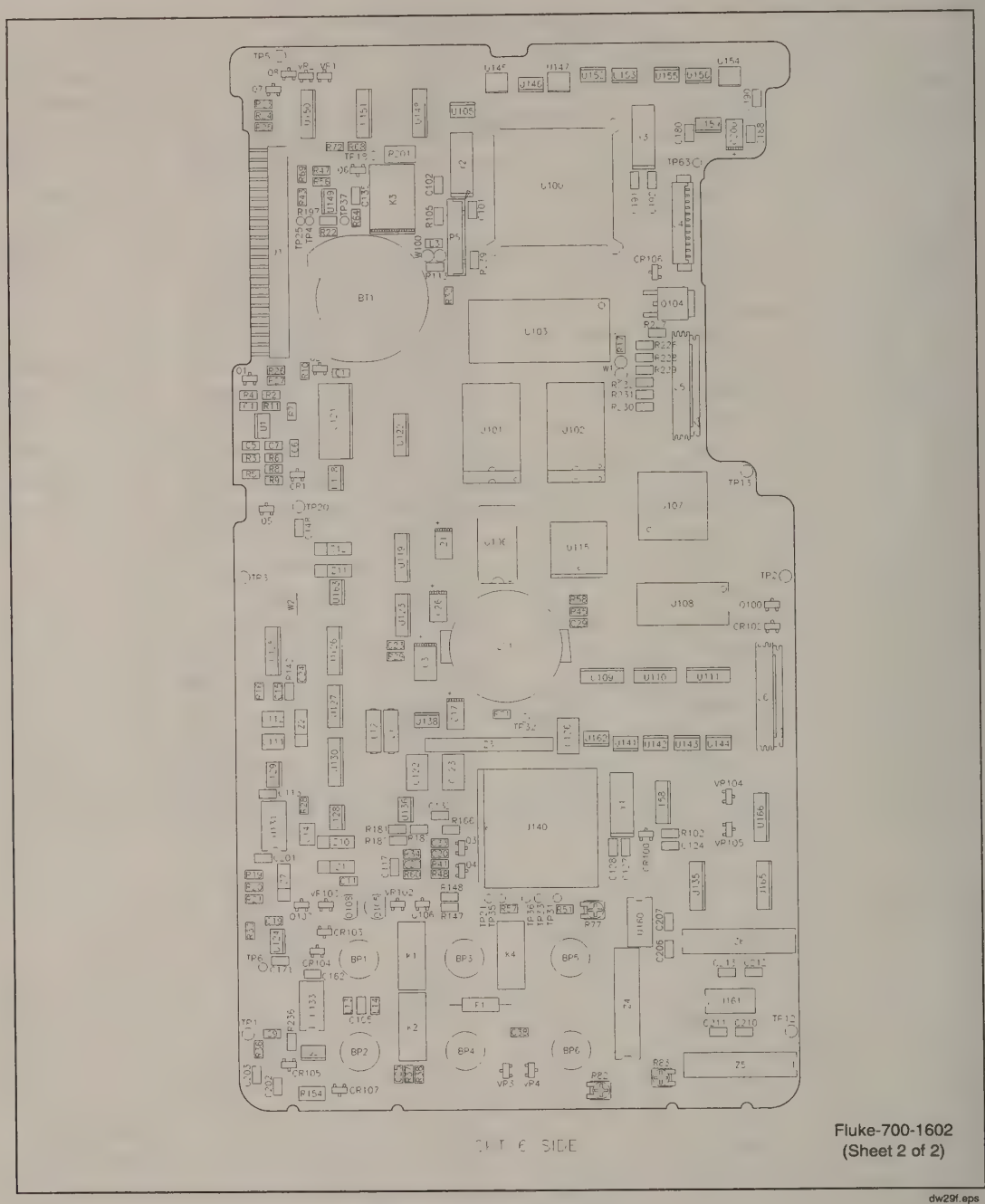

Figure 4-3. A2 Main PCA (cont)

Table 4-4. A4 Connector PCA

Reference Designator	Description	Fluke Stock No	Tot Qty	Notes
H23, 24	SCREW,PH,P,SS,440,.250	558791	2	2
H19	CONN ACC,D-SUB,JACK SCREW,4-40	448092	2	1
J4	HEADER,1 ROW,1.25MM CTR,RT ANG,12 PIN	943753	1	
J7	JACK,PANEL/PWB,2.54 MM,PIN	942730	1	
MP1, 2	SPACER,BROACH,.219 RND,SS,4-40,.375	942631	2	
MP4	I/O BRACKET	938253	1	
MP16	701 I/O PLUG	938266	1	2
P3	CONNECTOR,CIRC,PANEL,REC,5 SCKT	942714	1	
P4	CONNECTOR,D-SUB,PWB,9 SCKT	942727	1	1
NOTE 1: USED ONLY ON 702				
NOTE 2: USED ONLY ON 701				

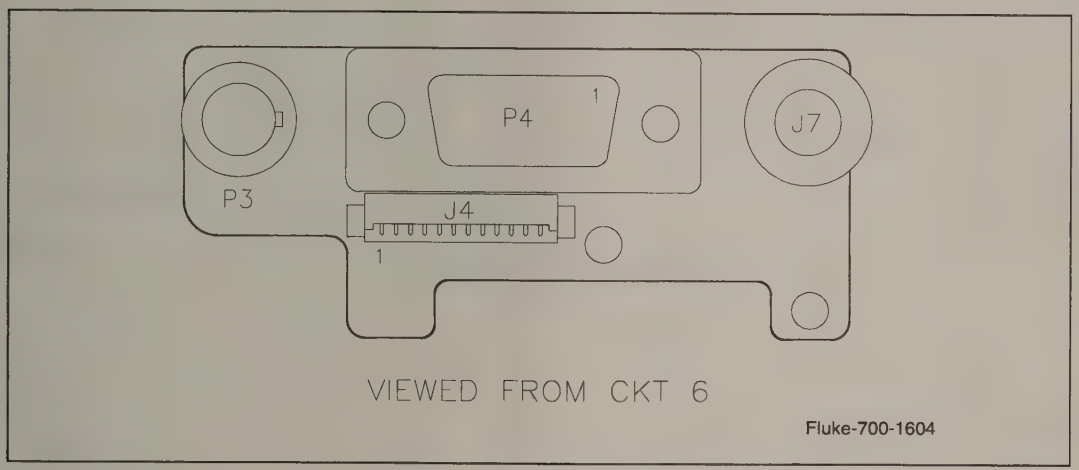

Figure 4-4. A4 Connector PCA

Table 4-5. A5 Thermal PCA

Reference Designator	Description	Fluke Stock No	Tot Qty	Notes
C1	CAP,CER,0.01UF,+-20%,100V,X7R,1206	742981	1	
E1, 2	T/C CONTACT	938204	2	
P2	HEADER,1 ROW,.100CTR,RT ANG,PEG,4 PIN	943464	1	
RT2	THERMISTOR,CHIP,NEG,10K10%,25C	942685	1	

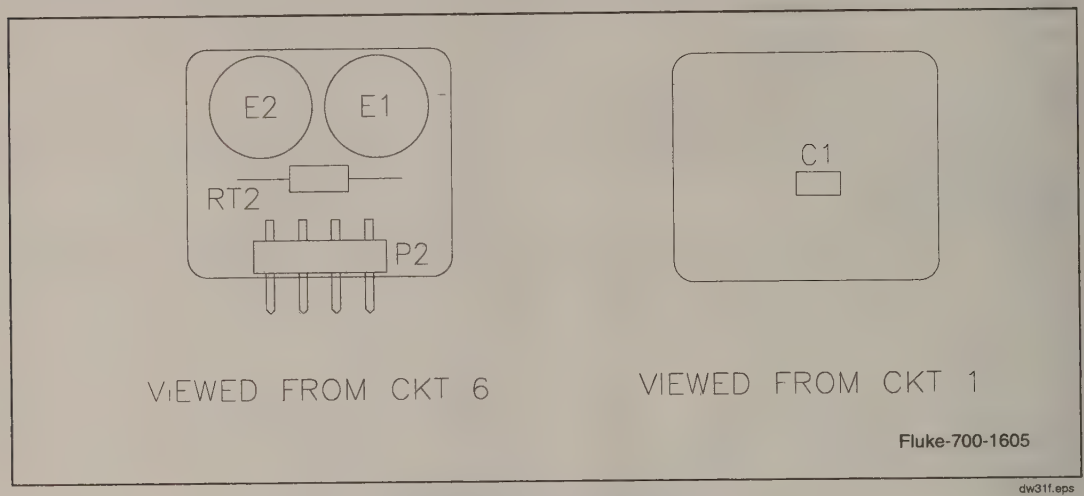

Figure 4-5. A5 Thermal PCA

Table 4-6. A6 Keyboard PCA

Reference Designator	Description	Fluke Stock No	Tot Qty	Notes
J1	CONN,FLAT FLEX,1MM CTR,RT ANG,16 POS	943779	1	

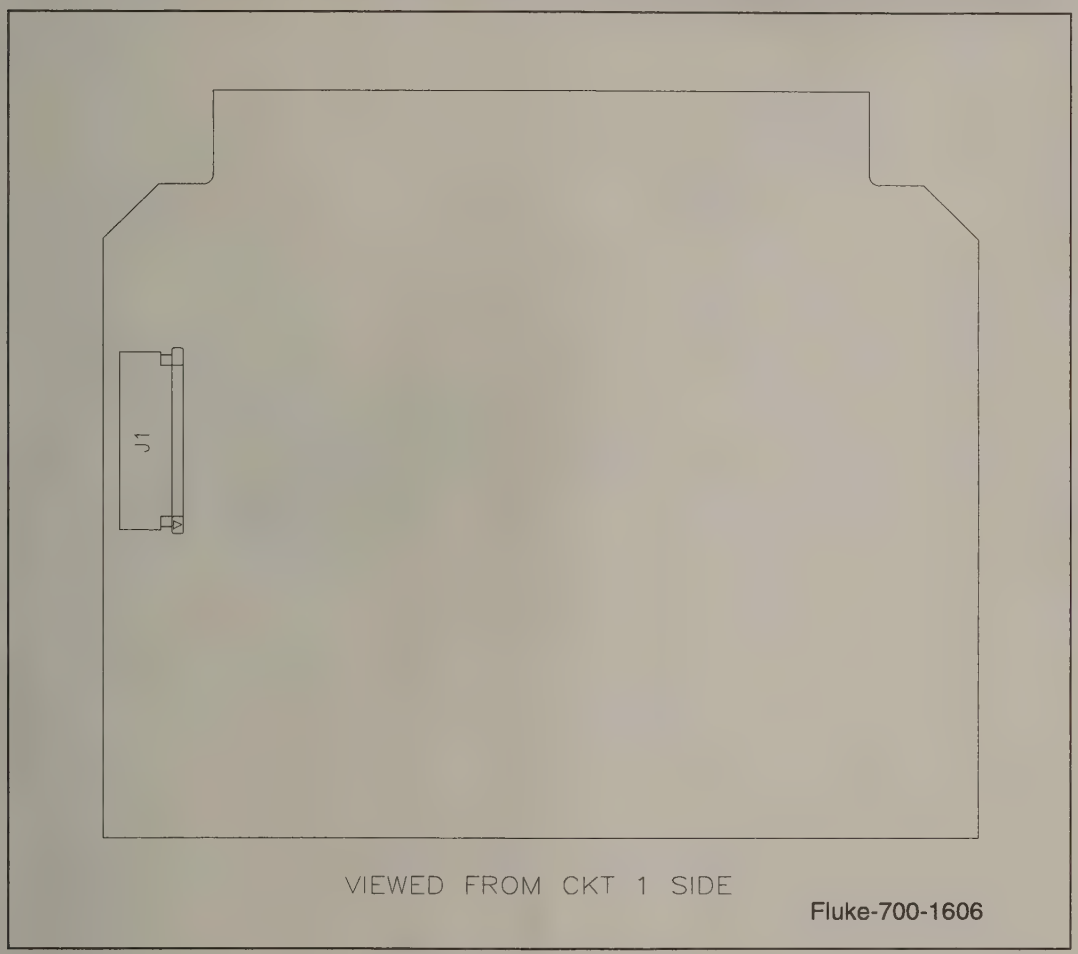

Figure 4-6. A6 Keyboard PCA

Chapter 5
Schematic Diagrams

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5-2	A2 Main PCA	5-5
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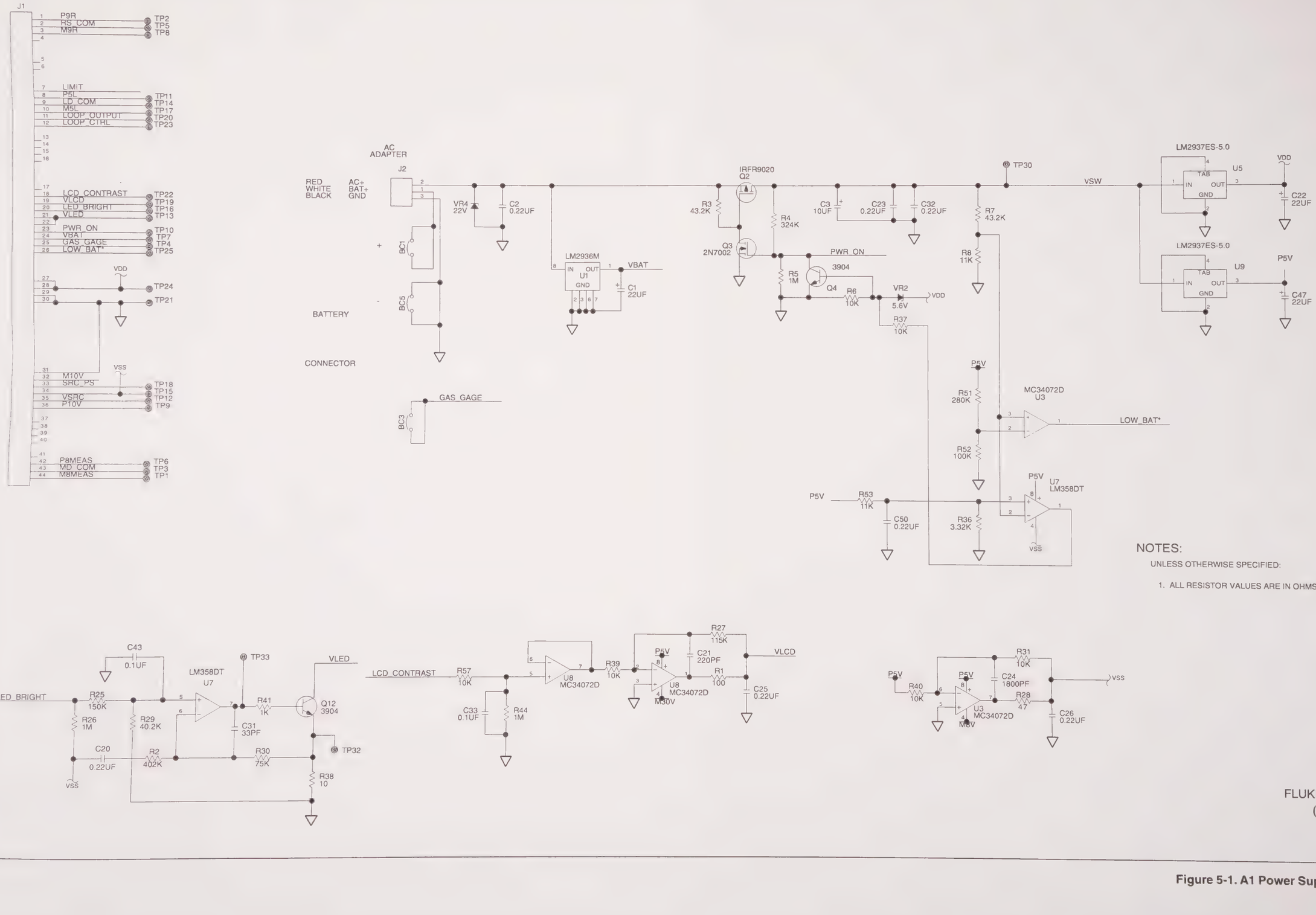

NOTES:

UNLESS OTHERWISE SPECIFIED:

1. ALL RESISTOR VALUES ARE IN OHMS.

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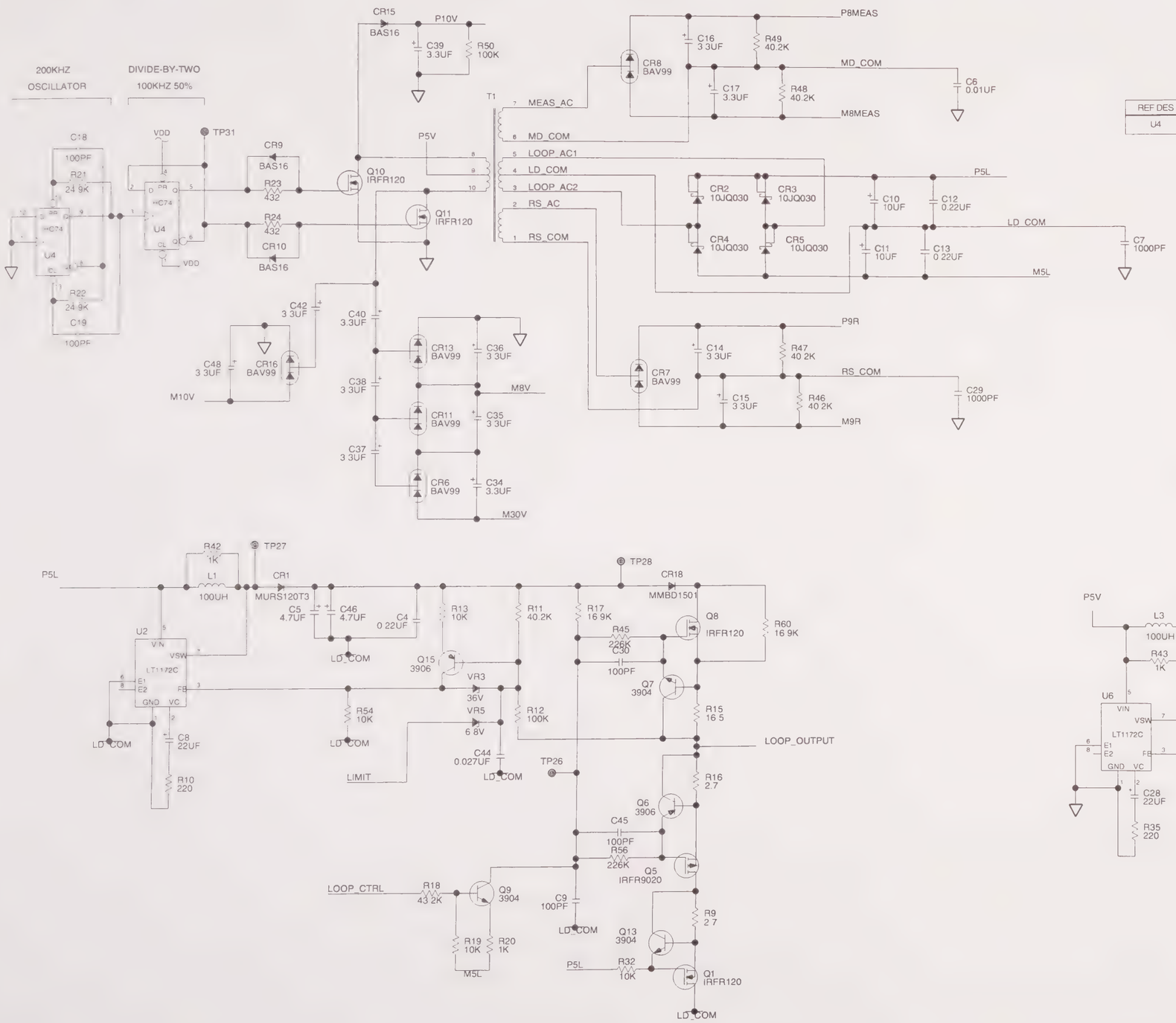
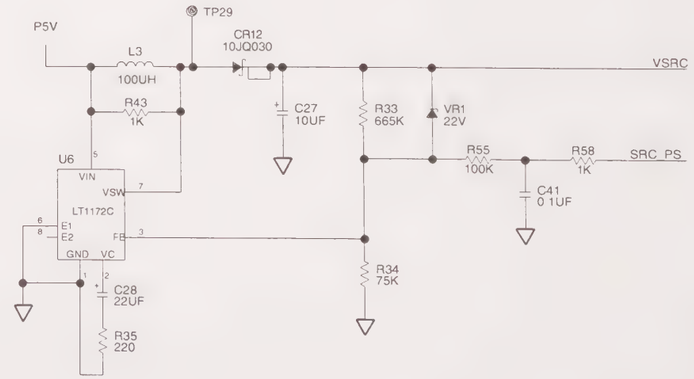
Figure 5-1. A1 Power Supply PCA



REF DES	PARTNAME	GND	VDD
U4	74HC74	7	14



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(2 of 2)

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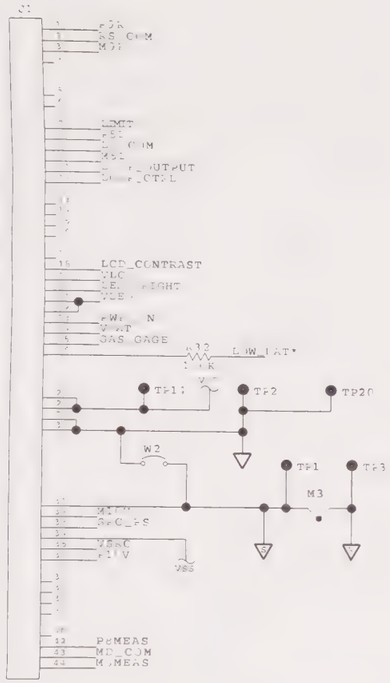
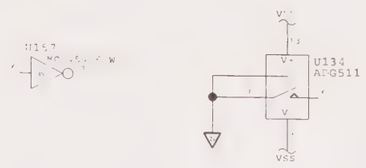
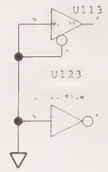
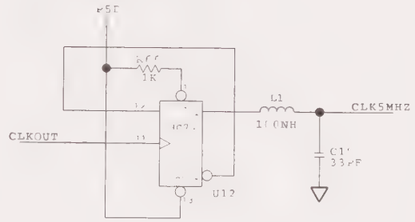
Figure 5-1. A1 Power Supply PCA (cont)

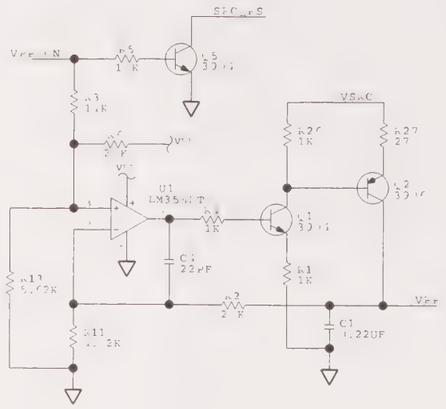
NOT USED

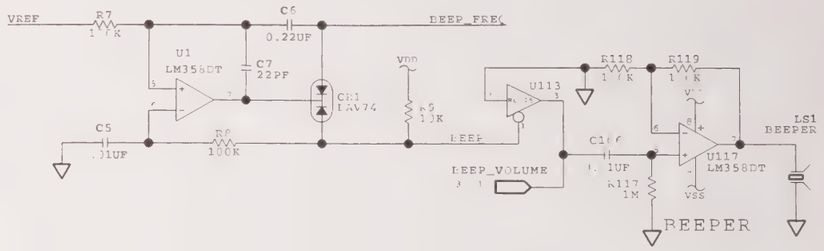








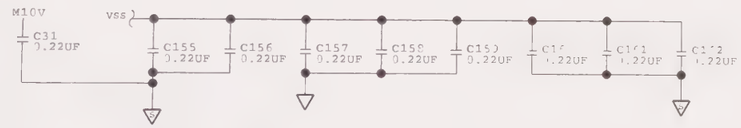


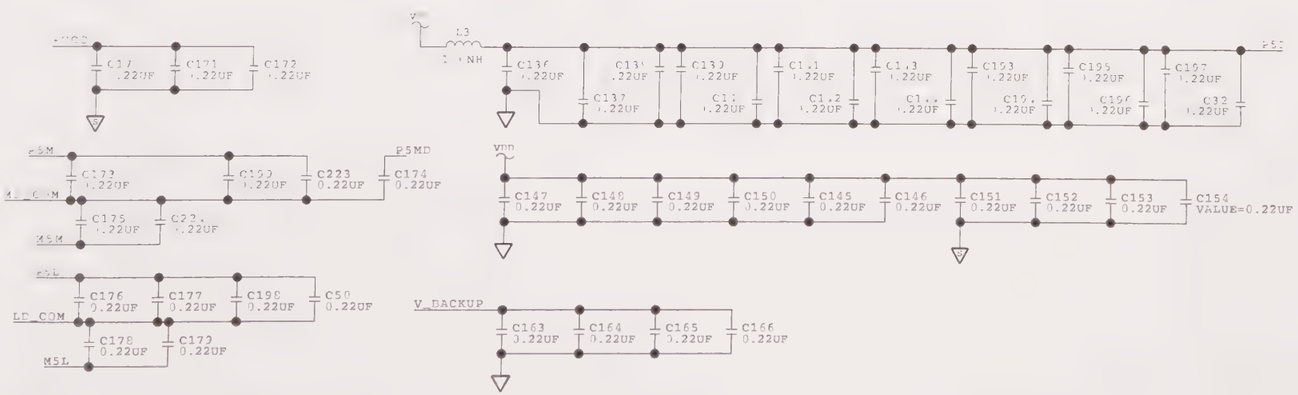


NOTES:

UNLESS OTHERWISE SPECIFIED:

1. ALL RESISTOR VALUES ARE IN OHMS.





REF DES	PARTNAME	GND	P5D	SGND	VBAT	VDD	V_BACKUP
U120	74HC74	7	14				
U115	CSK2C54	14	28				
U108	HM62256LFP-12T	14	28				
U100	MC68306	121,1,13, 22,34,46, 55,67,79, 88,100,112	127,7,28, 40,61,73, 94,106				
U103	PA28F400BX	13,32	23				
U107	SED1335F0B	35	21				
U113	74HC125	7					
U119	CD4094BE	8				1	
U122,U123	CD74ACT14M	7				1	
U114	MAX694	3				1	
U109-111	74HC126	7				2	
U112	74HC126	7			14		
U101,U102	HM628128LFP-10	16					14
U106	RTC64613	1,12,21					32
U127	CD74ACT00M			7			24
U125	ADG411			5		1	
U126,U130,	ADG511			5		12	
U134						12	
U128	MAX543BCS			2		8	

REF DES	PARTNAME	LD_COM	M5_COM	P5L	P5M	P5MI	P5R	RS_COM
U157	MC145406DW						16	9
U158	74HC02		7					
U166	CD4094BE		8			11		
U135	ADG511		5			16		
U148	CD4094BE				12			
U150	ADG511	5		16				
				12				

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Figure 5-2. A2 Main PCA

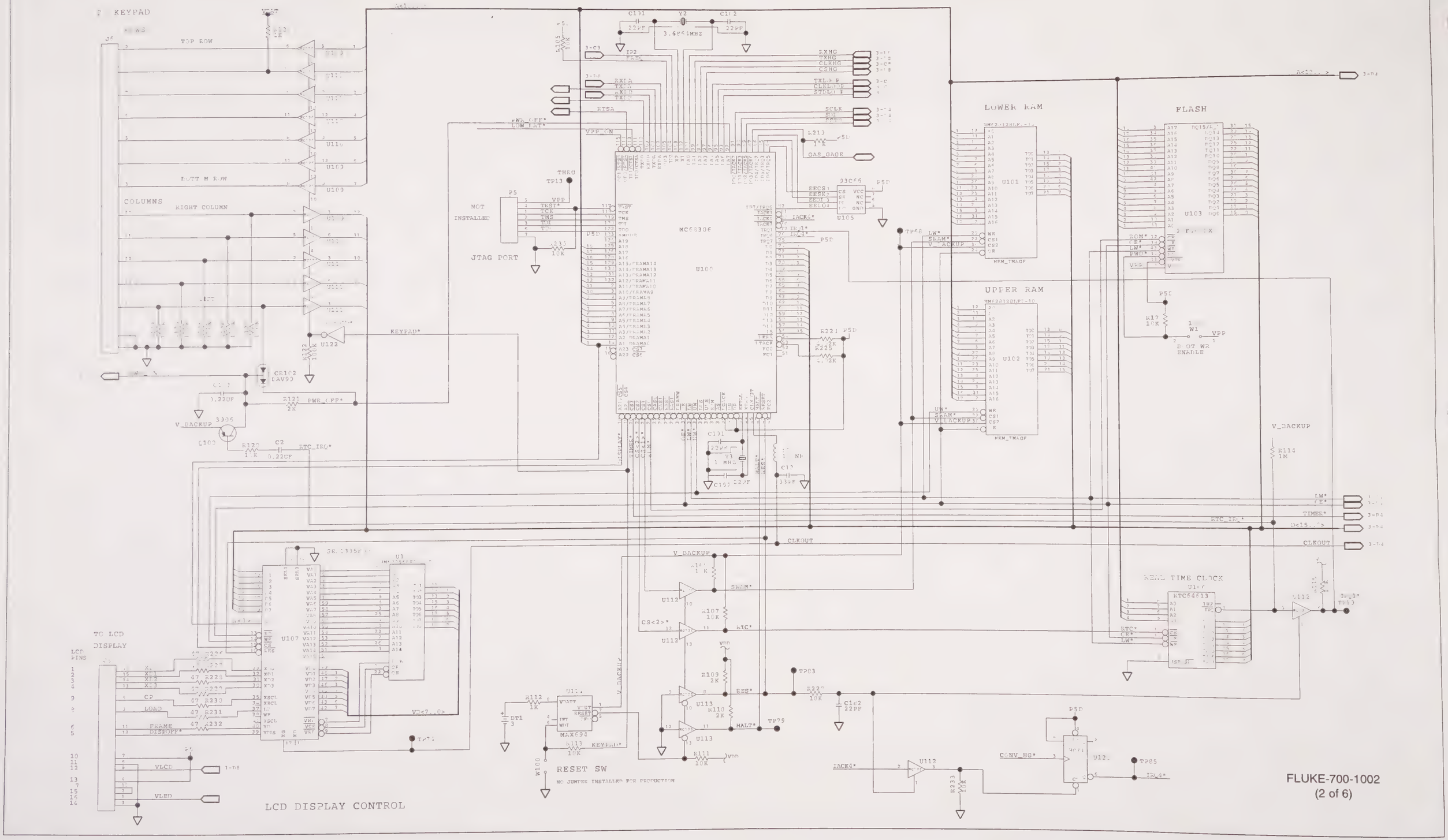

Figure 5-2. A2 Main PCA (cont)

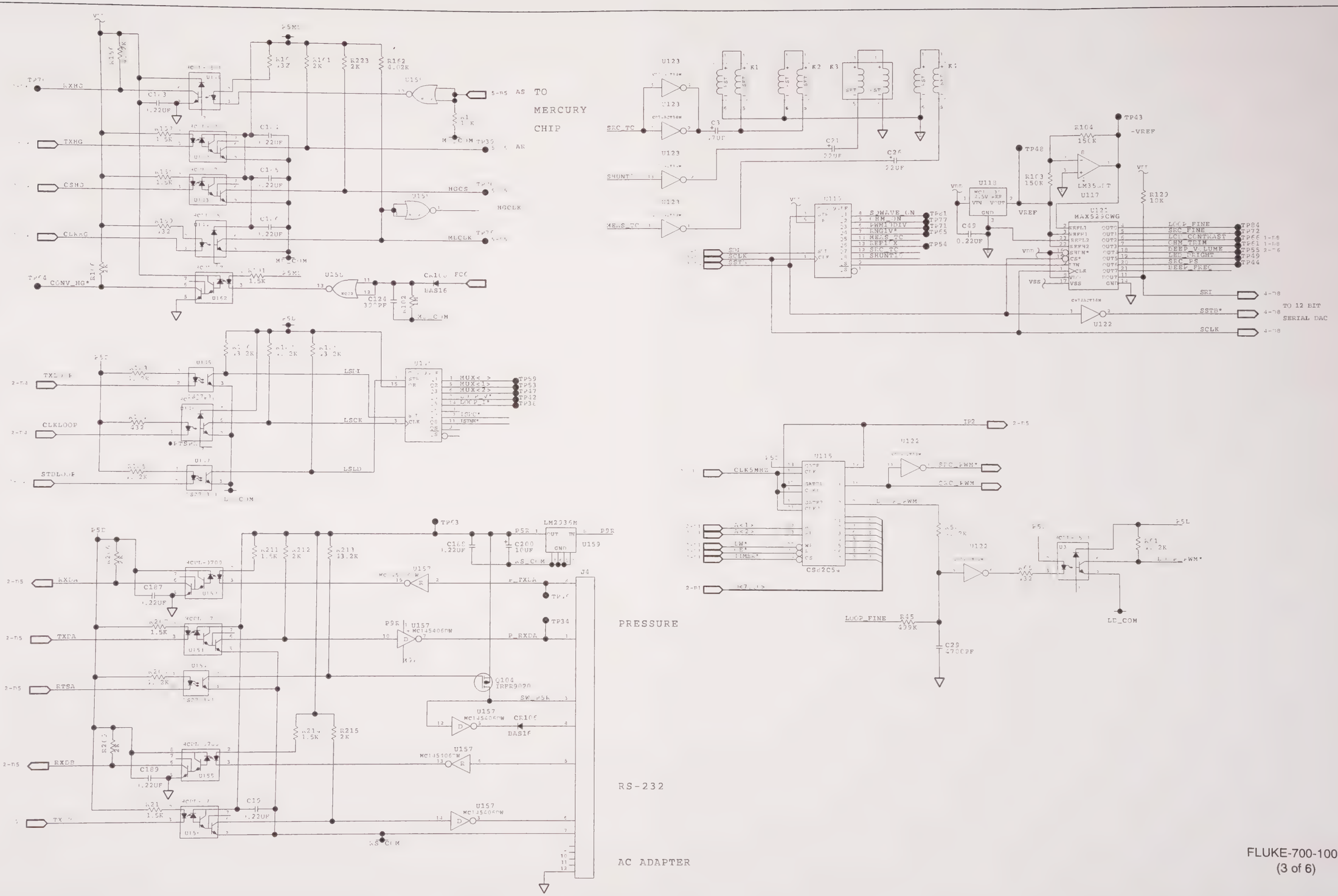

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Figure 5-2. A2 Main PCA (cont)

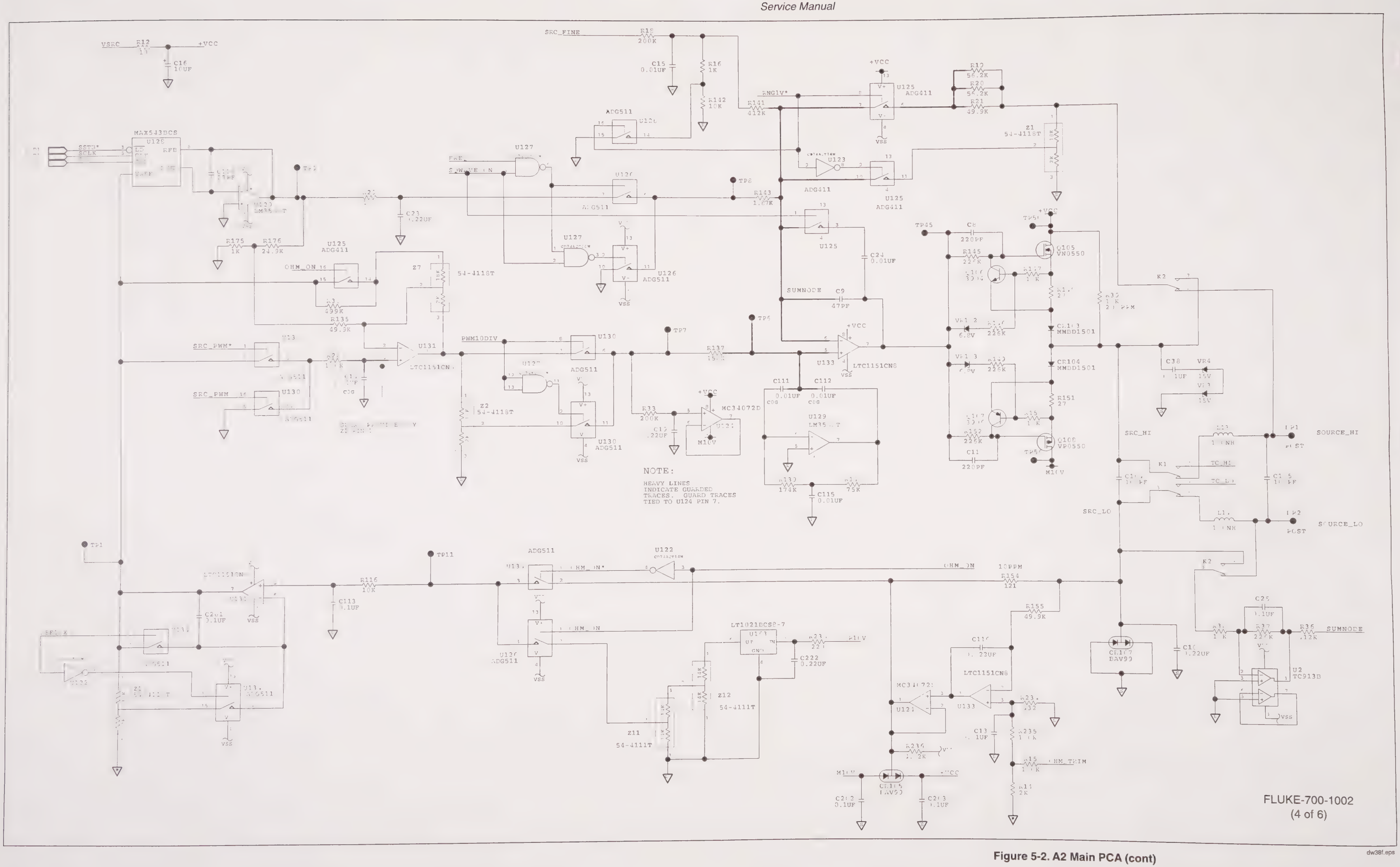

Figure 5-2. A2 Main PCA (cont)

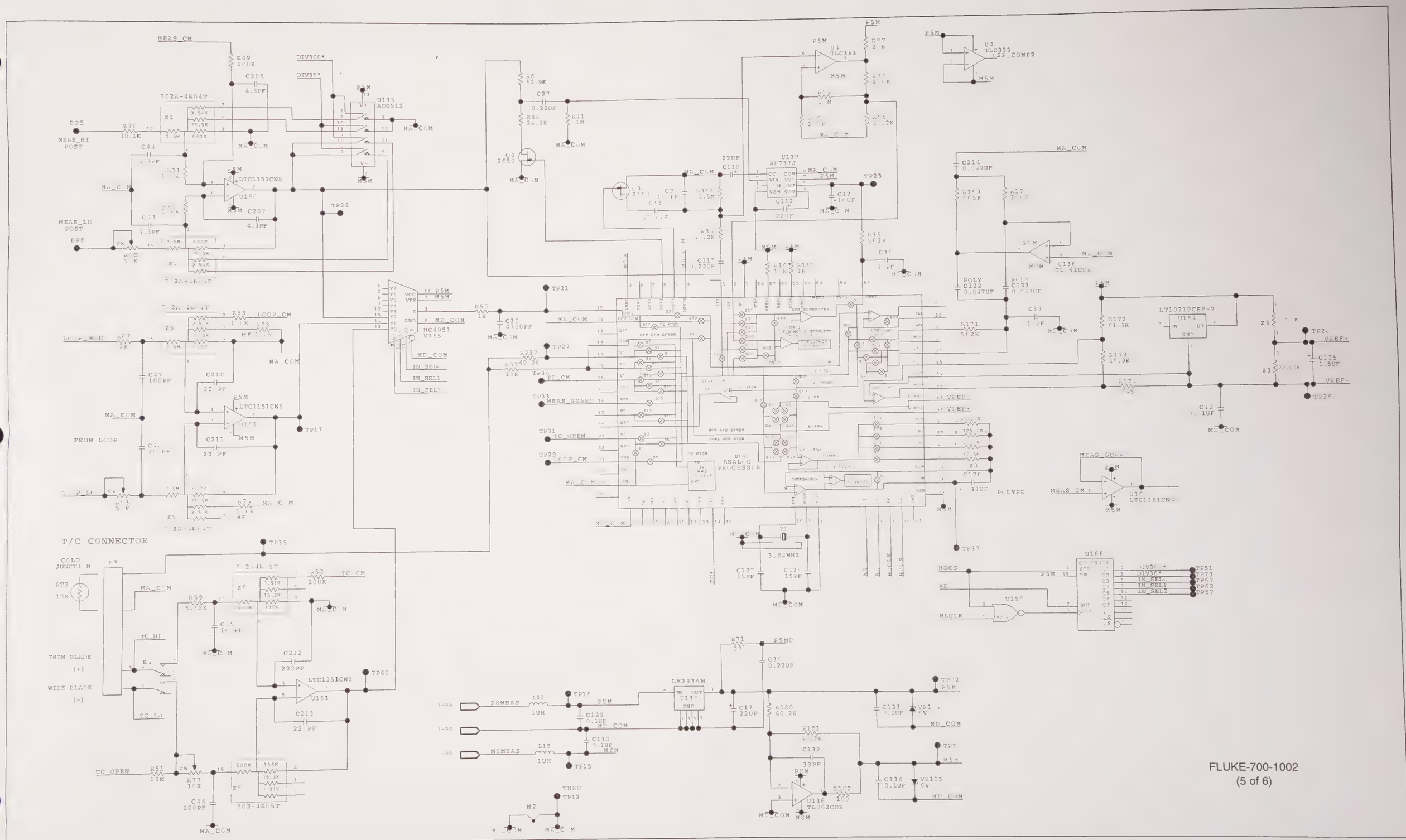

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Figure 5-2. A2 Main PCA (cont)

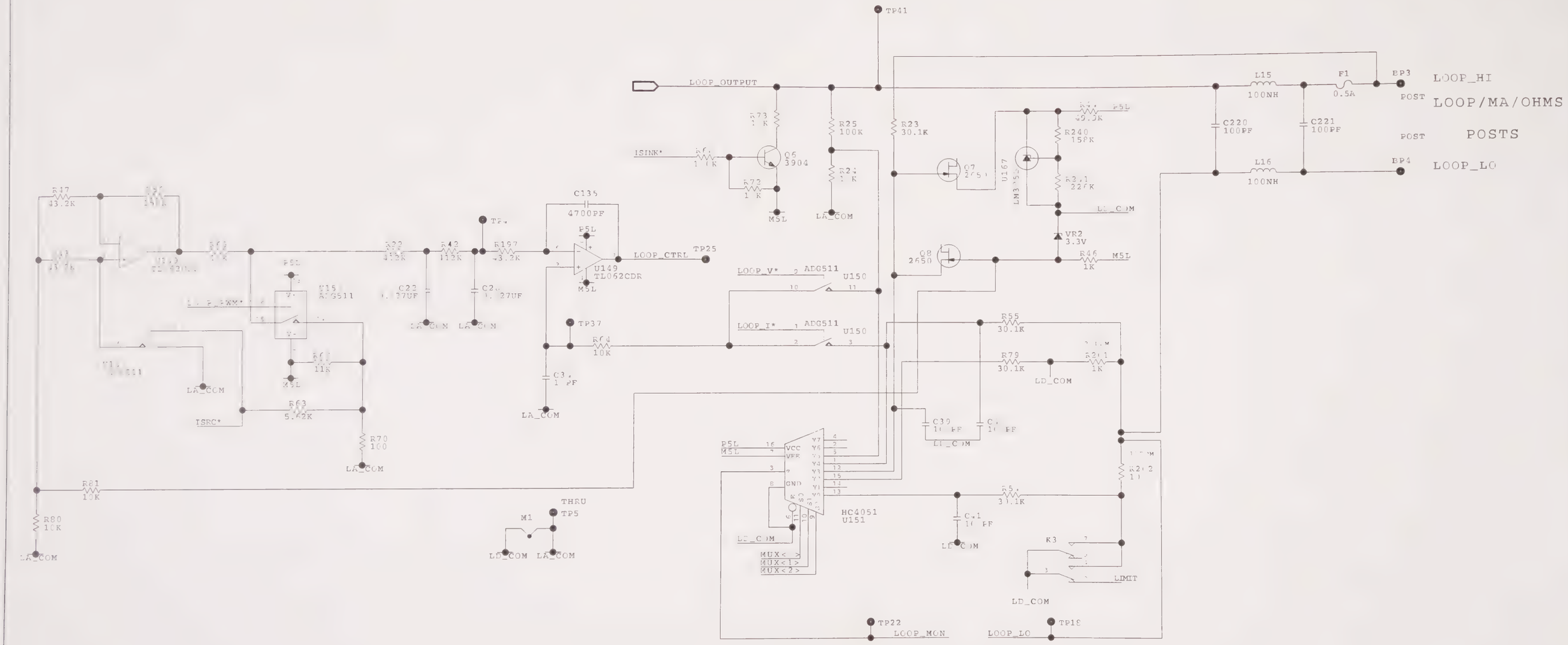

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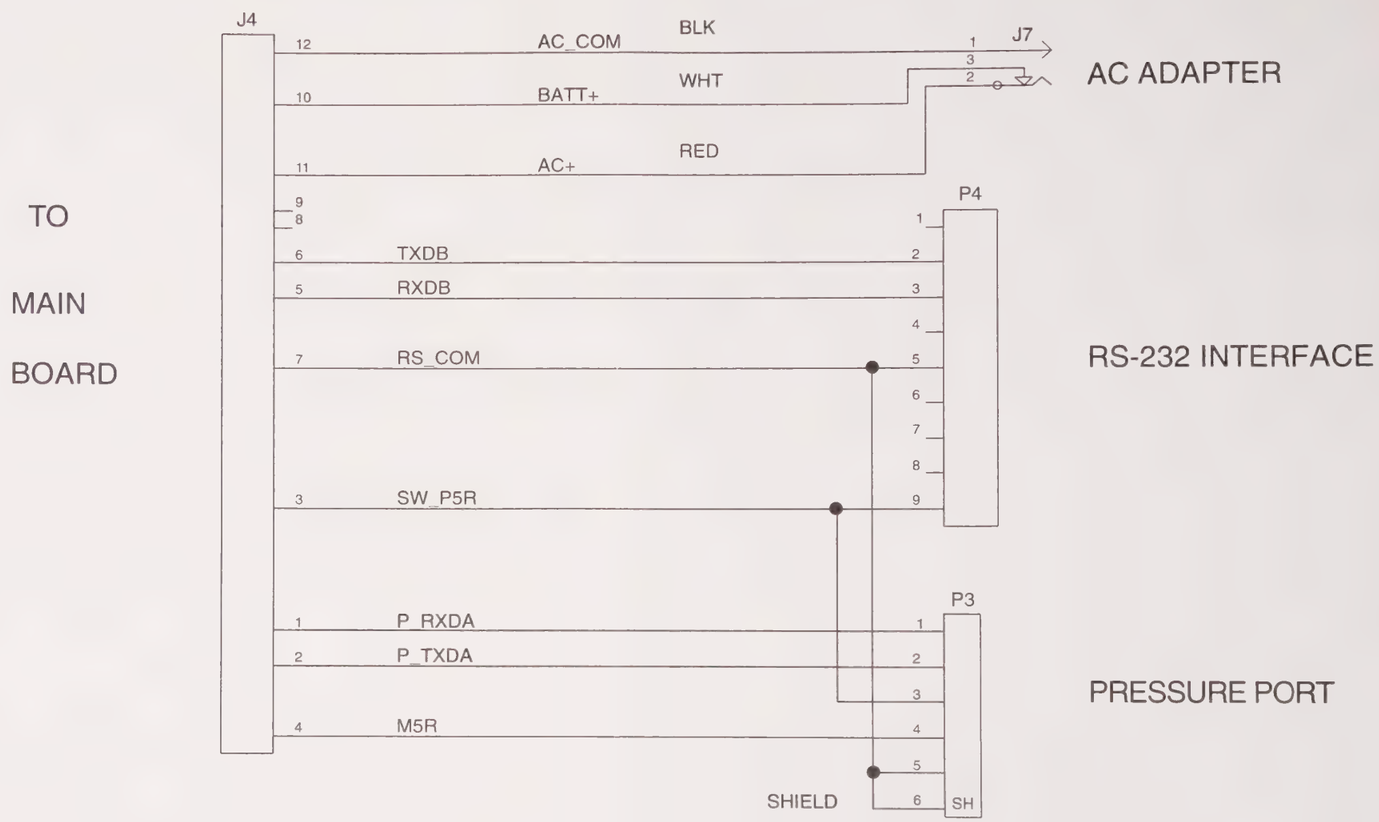
Figure 5-2. A2 Main PCA (cont)



NOTES:

UNLESS OTHERWISE SPECIFIED:

1. ALL RESISTOR VALUES ARE IN OHMS.

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Figure 5-3. A4 Connector PCA

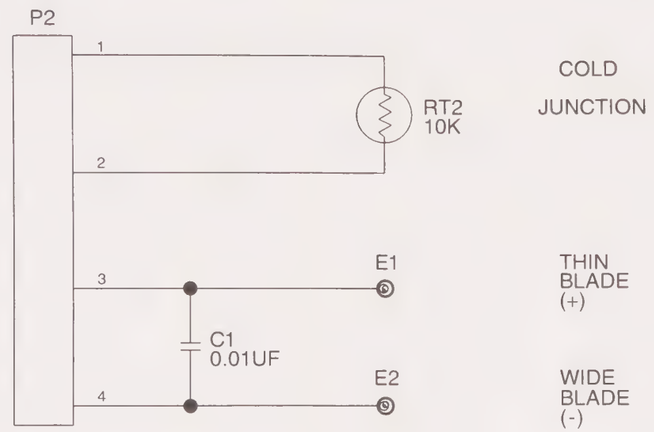

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Figure 5-4. A5 Thermal PCA

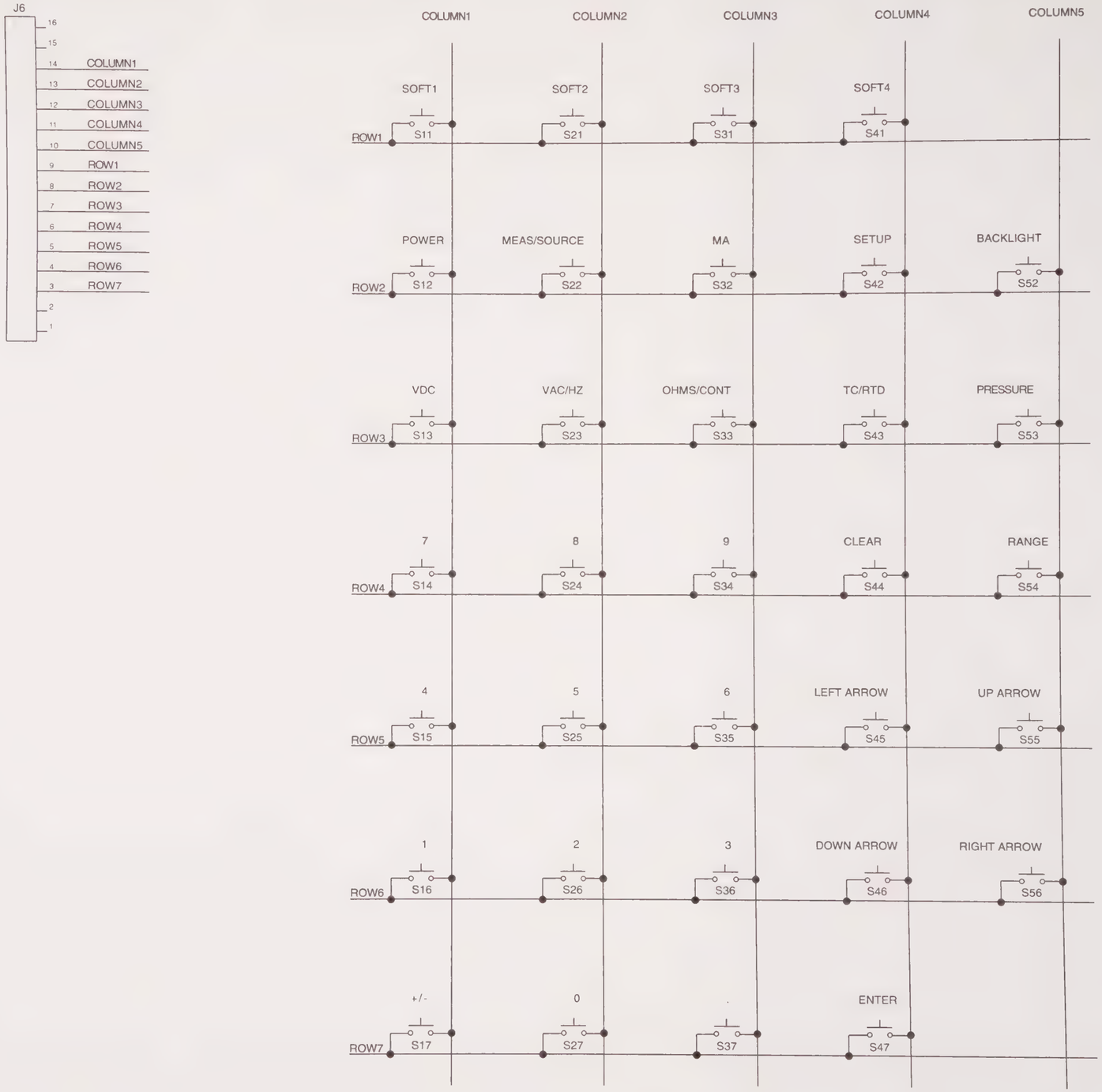

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Figure 5-5. A6 Keyboard PCA

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